

San Mateo County Library



3 9041 07254858 8

ASTRONOMICAL PHENOMENA

FOR THE YEAR

2011

Prepared Jointly by
The Nautical Almanac Office
United States Naval Observatory
and

Her Majesty's Nautical Almanac Office
United Kingdom Hydrographic Office

LIBRARY
USE
ONLY

WASHINGTON
U.S. Government Printing Office

2008

SCIENCE
ASTRON

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (86) 512-1800 DC area (202) 512-1800
Fax: (202) 512-2250 Mail: Stop IDCC, Washington, DC 20402-0001

ISBN 0-16-082126-X

SCC
3/10

ASTRONOMICAL PHENOMENA

FOR THE YEAR

2011

Prepared Jointly by
The Nautical Almanac Office
United States Naval Observatory

and

Her Majesty's Nautical Almanac Office
United Kingdom Hydrographic Office

WASHINGTON
U.S. Government Printing Office

2008

UNITED STATES

Printed in the United States of America
by the U. S. Government Printing Office
by permission

For sale by the
U.S. Government Printing Office
Superintendent of Documents
P. O. Box 371954
Pittsburgh, PA 15250-7954
phone: 1-202-512-1800
order online at <http://bookstore.gpo.gov/>

UNITED KINGDOM

© *Crown Copyright 2008*

This publication is protected by international copyright law. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of Her Majesty's Nautical Almanac Office, which is part of the UK Hydrographic Office, Admiralty Way, Taunton, Somerset TA1 2DN, United Kingdom.

The following United States government work is excepted from the above notice, and no copyright is claimed for it in the United States: cover, title page and reverse, pages 64-73, 75-78.

Available from
HM Nautical Almanac Office
UK Hydrographic Office
Admiralty Way
Taunton
Somerset TA1 2DN
hmnao@ukho.gov.uk

Further information:
<http://aa.usno.navy.mil/>
<http://www.hmnao.com/>
<http://www.admiraltyshop.co.uk/>

ASTRONOMICAL PHENOMENA

FOR THE YEAR 2011

CONTENTS

	Page
Phenomena: Seasons, Moon Phases, Eclipses	4
Occultations, Perigee and Apogee of the Moon	5
Geocentric and Heliocentric Planetary Phenomena	6
Visibility of the Planets	7, 8
Times of Meridian Passages of the Planets	9
Elongations and Magnitudes of the Planets	10
Diary of Configurations of the Sun, Moon and Planets	12
Perihelion Passages of Comets	14
Chronological Cycles and Eras; Religious and Civil Holidays	15
Gregorian Calendar and Julian Day Numbers	16
Mean Sidereal Time	17
Sun: Equation of Time and Declination	18
Circumpolar Stars: Positions of <i>Polaris</i> and σ Octantis	20
International Time Zones	22
Explanation of Rising and Setting Tables	23
Sunrise and Sunset Tables	24
Moonrise and Moonset Tables	32
Eclipses	64
Related Publications	80
Web Links	82

The astronomical data in this booklet are expressed in the scale of universal time (UT); this is also known as Greenwich mean time (GMT) and is the standard time of the Greenwich meridian (0° of longitude). A time in UT may be converted to local mean time by the addition of east longitude (or subtraction of west longitude), where the longitude of the place is expressed in time-measure at the rate of 1 hour for every 15° . The differences between standard times and UT are indicated in the chart on page 22; local clock times may, however, differ from these standard times, especially in summer when clocks are often advanced by 1 hour.

PRINCIPAL PHENOMENA OF SUN AND MOON, 2011

THE SUN

THE SUN															
		d	h			d	h	m			d	h	m		
Perigee	...	Jan.	3	19	Equinoxes	...	Mar.	20	23	21	...	Sept.	23	09	05
Apogee	...	July	4	15	Solstices	...	June	21	17	16	...	Dec.	22	05	30

PHASES OF THE MOON

Lunation	New Moon	First Quarter	Full Moon	Last Quarter
	d h m	d h m	d h m	d h m
1089	Jan. 4 09 03	Jan. 12 11 31	Jan. 19 21 21	Jan. 26 12 57
1090	Feb. 3 02 31	Feb. 11 07 18	Feb. 18 08 36	Feb. 24 23 26
1091	Mar. 4 20 46	Mar. 12 23 45	Mar. 19 18 10	Mar. 26 12 07
1092	Apr. 3 14 32	Apr. 11 12 05	Apr. 18 02 44	Apr. 25 02 47
1093	May 3 06 51	May 10 20 33	May 17 11 09	May 24 18 52
1094	June 1 21 03	June 9 02 11	June 15 20 14	June 23 11 48
1095	July 1 08 54	July 8 06 29	July 15 06 40	July 23 05 02
1096	July 30 18 40	Aug. 6 11 08	Aug. 13 18 57	Aug. 21 21 54
1097	Aug. 29 03 04	Sept. 4 17 39	Sept. 12 09 27	Sept. 20 13 39
1098	Sept. 27 11 09	Oct. 4 03 15	Oct. 12 02 06	Oct. 20 03 30
1099	Oct. 26 19 56	Nov. 2 16 38	Nov. 10 20 16	Nov. 18 15 09
1100	Nov. 25 06 10	Dec. 2 09 52	Dec. 10 14 36	Dec. 18 00 48
1101	Dec. 24 18 06			

ECLIPSE

A partial eclipse of the Sun	Jan. 4	Most of Europe, the northern half of Africa, the Middle East, western Asia, north-west China, western Mongolia and the north-west part of India.
A partial eclipse of the Sun	June 1	Eastern Asia except southern Japan, northern Alaska, northern Canada, the northern tip of Scandinavia, Greenland and Iceland.
A total eclipse of the Moon	June 15	Australasia, Japan, Asia except the northern part, India, Africa, Europe and South America except the north-west part.
A partial eclipse of the Sun	July 1	Southern Ocean between Antarctica and southern Africa.
A partial eclipse of the Sun	Nov. 25	Southern tip of South Africa, Antarctica, Tasmania and New Zealand.
A total eclipse of the Moon	Dec. 10	North America except the eastern part, the northern half of Mexico, the Hawaiian Islands, Oceania, Australasia, Asia, eastern Africa, Iceland and most of Europe.

MOON AT PERIGEE

	d	h		d	h		d	h
Jan.	22	00	June	12	02	Oct.	26	12
Feb.	19	07	July	7	14	Nov.	23	23
Mar.	19	19	Aug.	2	21	Dec.	22	03
Apr.	17	06	Aug.	30	18			
May	15	11	Sept.	28	01			

MOON AT APOGEE

	d	h		d	h		d	h
Jan.	10	06	May	27	10	Oct.	12	12
Feb.	6	23	June	24	04	Nov.	8	13
Mar.	6	08	July	21	23	Dec.	6	01
Apr.	2	09	Aug.	18	16			
Apr.	29	18	Sept.	15	06			

OCCULTATIONS OF PLANETS AND BRIGHT STARS BY THE MOON

Date	Body	Areas of Visibility
d h		
Feb 28 00	Vesta	Antarctica, S. Pacific Ocean
Mar 28 07	Vesta	Iceland
July 27 17	Mars	Samoa, Republic of Kiribati, French Polynesia, southern half of South America except southernmost tip
Oct 28 02	Mercury	Malaysia, Indonesia, S.E. Papua New Guinea, Australia, New Zealand, New Caledonia, French Polynesia

Maps showing the areas of visibility may be found on AsA-Online.

GEOCENTRIC PHENOMENA

MERCURY

	d	h		d	h		d	h		d	h
Greatest elongation West	Jan.	9 15 (23°)	May	7 19 (27°)	Sept.	3 06 (18°)	Dec.	23 03 (22°)			
Superior conjunction ...	Feb.	25 09	June	13 00	Sept.	28 20		—			
Greatest elongation East	Mar.	23 01 (19°)	July	20 05 (27°)	Nov.	14 09 (23°)		—			
Stationary	Mar.	30 17	Aug.	2 07	Nov.	24 10		—			
Inferior conjunction ...	Apr.	9 20	Aug.	17 01	Dec.	4 09		—			
Stationary	Apr.	22 05	Aug.	26 04	Dec.	14 02		—			

VENUS

	d	h		d	h
Greatest elongation West	Jan.	8 16 (47°)	Superior conjunction ...	Aug.	16 12

EARTH

	d	h		d	h	m		d	h	m
Perihelion	Jan.	3 19	Equinoxes ...	Mar.	20 23 21		Sept.	23 09 05		
Aphelion ...	July	4 15	Solstices ...	June	21 17 16		Dec.	22 05 30		

SUPERIOR PLANETS & PLUTO

		Conjunction		Stationary		Opposition		Stationary		
		d	h		d	h	d	h	d	h
Mars	...	Feb.	4 17		—		—		—	
Jupiter	...	Apr.	6 15	Aug.	30 17		Oct.	29 02	Dec.	26 11
Saturn	...	Oct.	13 21	| Jan.	27 08		Apr.	4 00	June	14 05
Uranus	...	Mar.	21 12	July	10 08		Sept.	26 00	Dec.	10 15
Neptune	...	Feb.	17 10	June	3 15		Aug.	22 23	Nov.	9 21
Pluto	...	Dec.	29 08	| Apr.	9 07		June	28 05	Sept.	16 12

The vertical bars indicate where the dates for the planet are not in chronological order.

HELIOCENTRIC PHENOMENA

	Aphelion	Perihelion	Descending Node	Greatest Lat. South	Ascending Node	Greatest Lat. North
Mercury	Jan. 31	Mar. 16	Jan. 21	Feb. 20	Mar. 11	Mar. 26
	Apr. 29	June 12	Apr. 18	May 19	June 7	June 22
	July 26	Sept. 8	July 15	Aug. 15	Sept. 3	Sept. 18
	Oct. 22	Dec. 5	Oct. 11	Nov. 11	Nov. 30	Dec. 15
Venus	Apr. 18	Aug. 9	Mar. 15	May 11	July 6	Jan. 18
	Nov. 29	—	Oct. 26	Dec. 21	—	Aug. 30
Mars	—	Mar. 9	—	Feb. 11	July 8	—
Jupiter	—	Mar. 17	—	Feb. 1	—	—

Saturn, Uranus, Neptune, Pluto: None in 2011

VISIBILITY OF PLANETS

MERCURY can only be seen low in the east before sunrise, or low in the west after sunset (about the time of beginning or end of civil twilight). It is visible in the mornings between the following approximate dates: January 1 to February 13, April 18 to June 5, August 25 to September 19 and December 10 to December 31. The planet is brighter at the end of each period, (the best conditions in northern latitudes occur in the first half of January and in the second half of December and in southern latitudes from late April to the end of the third week of May). It is visible in the evenings between the following approximate dates: March 7 to April 2, June 20 to August 9 and October 12 to November 28. The planet is brighter at the beginning of each period, (the best conditions in northern latitudes occur in the second half of March and in southern latitudes in July from the beginning of the second week).

VENUS is a brilliant object in the morning sky from the beginning of the year until near the end of the second week of July when it becomes too close to the Sun for observation. During the second half of September it reappears in the evening sky where it stays until the end of the year. Venus is in conjunction with Jupiter on May 11 and with Mars on May 22.

MARS is too close to the Sun for observation until mid-April when it appears in the morning sky in Pisces. Its westward elongation gradually increases as it passes through Aries, Taurus (passing 5° N of *Aldebaran* on July 6), Gemini (passing 6° S of *Pollux* on September 10), Cancer and into Leo (passing $1^{\circ}4'$ N of *Regulus* on November 10). Mars is in conjunction with Mercury on April 19 and May 20, with Jupiter on May 1 and with Venus on May 22.

JUPITER can be seen at the beginning of the year in the evening sky in Pisces, moves into Cetus in late February and back into Pisces in early March. From late March it becomes too close to the Sun for observation. It reappears in the morning sky in the second half of April and moves into Aries in early June. Its westward elongation gradually increases and from the beginning of August it can be seen for more than half the night. It is at opposition on October 29 when it is visible throughout the night. Its eastward elongation gradually decreases and at the end of the first week of December it passes once more into Pisces. Jupiter is in conjunction with Mercury on March 16 and May 10, with Mars on May 1 and with Venus on May 11.

SATURN rises shortly after midnight at the beginning of the year in Virgo and remains in this constellation throughout the year (passing 5° N of *Spica* on October 31). Saturn is at opposition on April 4 when it can be seen throughout the night, and from early July until late September it is visible only in the evening sky. It then becomes too close to the Sun for observation until the end of October, after which it can be seen in the morning sky for the rest of the year.

URANUS is visible at the beginning of the year in the evening sky in Pisces and remains in this constellation throughout the year. From the beginning of March it becomes too close to the Sun for observation and reappears in the second week of April in the morning sky. Uranus is at opposition on September 26. Its eastward elongation gradually decreases and from late December it can only be seen in the evening sky.

NEPTUNE is visible at the beginning of the year in the evening sky in Capricornus, moves into Aquarius in the second half of January and remains in this constellation for the rest of the year. In late January it becomes too close to the Sun for observation and reappears in the second week of March in the morning sky. Neptune is at opposition on August 22 and from late November can be seen only in the evening sky.

DO NOT CONFUSE (1) Jupiter with Mercury in mid-March and in the first half of May and with Mars in late April to early May; on all occasions Jupiter is the brighter object. (2) Mercury with Mars in the second half of April when Mars is the brighter object. (3) Venus with Mercury from late April to late May and mid-October to late November, with Jupiter in the first half of May, with Mars from mid-May to early June and with Saturn in late September; on all occasions Venus is the brighter object. (4) Mercury with Mars in mid-May when Mercury is the brighter object.

VISIBILITY OF PLANETS IN MORNING AND EVENING TWILIGHT

	Morning	Evening
Venus	January 1 – July 11	September 23 – December 31
Mars	April 17 – December 31	
Jupiter	April 21 – October 29	January 1 – March 24 October 29 – December 31
Saturn	January 1 – April 4 October 31 – December 31	April 4 – September 26

VISIBILITY OF PLANETS

The planet diagram on page 9 shows, in graphical form for any date during the year, the local mean times of meridian passage of the Sun, of the five planets, Mercury, Venus, Mars, Jupiter and Saturn, and of every 2^h of right ascension. Intermediate lines, corresponding to particular stars, may be drawn in by the user if desired. The diagram is intended to provide a general picture of the availability of planets and stars for observation during the year.

On each side of the line marking the time of meridian passage of the Sun, a band 45^m wide is shaded to indicate that planets and most stars crossing the meridian within 45^m of the Sun are generally too close to the Sun for observation.

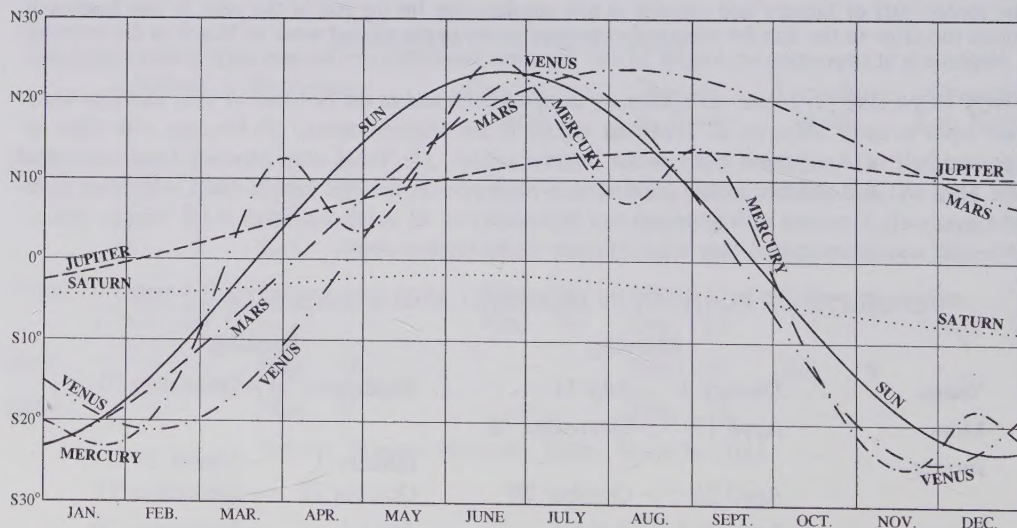
For any date the diagram provides immediately the local mean time of meridian passage of the Sun, planets and stars, and thus the following information:

- whether a planet or star is too close to the Sun for observation;
- visibility of a planet or star in the morning or evening;
- location of a planet or star during twilight;
- proximity of planets to stars or other planets.

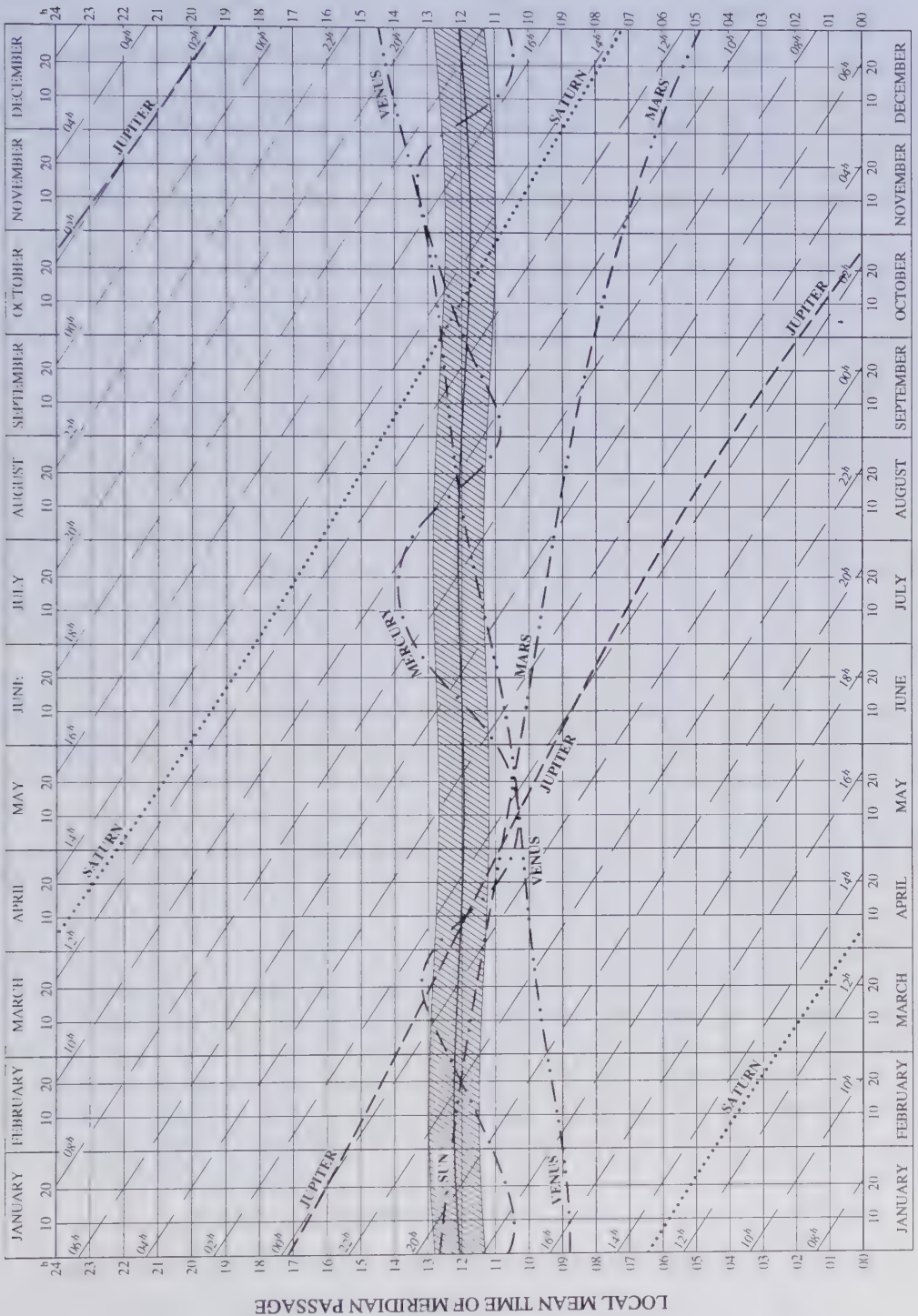
When the meridian passage of a body occurs at midnight, it is close to opposition to the Sun and is visible all night, and may be observed in both morning and evening twilights. As the time of meridian passage decreases, the body ceases to be observable in the morning, but its altitude above the eastern horizon during evening twilight gradually increases until it is on the meridian at evening twilight. From then onwards the body is observable above the western horizon, its altitude at evening twilight gradually decreasing, until it becomes too close to the Sun for observation. When it again becomes visible, it is seen in the morning twilight, low in the east. Its altitude at morning twilight gradually increases until meridian passage occurs at the time of morning twilight, then as the time of meridian passage decreases to 0^h , the body is observable in the west in the morning twilight with a gradually decreasing altitude, until it once again reaches opposition.

Notes on the visibility of the planets are given on page 7. Further information on the visibility of planets may be obtained from the diagram below which shows, in graphical form for any date during the year, the declinations of the bodies plotted on the planet diagram on page 9.

DECLINATION OF SUN AND PLANETS, 2011



LOCAL MEAN TIME OF MERIDIAN PASSAGE



ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Date	Mercury		Venus		Date	Mercury		Venus	
	Elong.	Mag.	Elong.	Mag.		Elong.	Mag.	Elong.	Mag.
Jan.	-1	W. 19	0	+0.4	July	3	E. 21	0	-0.4
	4	W. 22	-0.2	W. 47		8	E. 24	-0.1	W. 12
	9	W. 23	-0.3	W. 47		13	E. 26	+0.1	W. 11
	14	W. 23	-0.3	W. 47		18	E. 27	+0.3	W. 9
	19	W. 22	-0.3	W. 47		23	E. 27	+0.5	W. 8
Feb.	24	W. 20	-0.3	W. 46	Aug.	28	E. 25	+0.8	W. 5
	29	W. 18	-0.3	W. 46		2	E. 22	+1.3	W. 4
	3	W. 15	-0.4	W. 45		7	E. 17	+2.2	W. 3
	8	W. 13	-0.5	W. 45		12	E. 10	+3.8	W. 2
	13	W. 10	-0.8	W. 44		17	E. 5	+5.3	E. 1
Mar.	18	W. 6	-1.1	W. 43	Sept.	22	W. 9	+3.6	E. 2
	23	W. 3	-1.6	W. 42		27	W. 15	+1.5	E. 3
	28	E. 3	-1.7	W. 42		1	W. 18	+0.1	E. 4
	5	E. 7	-1.5	W. 41		6	W. 18	-0.7	E. 6
	10	E. 11	-1.3	W. 40		11	W. 15	-1.0	E. 7
Apr.	15	E. 15	-1.1	W. 39	Oct.	16	W. 11	-1.2	E. 8
	20	E. 18	-0.7	W. 38		21	W. 7	-1.4	E. 10
	25	E. 18	+0.1	W. 37		26	W. 3	-1.7	E. 11
	30	E. 16	+1.4	W. 36		1	E. 2	-1.6	E. 12
	4	E. 10	+3.4	W. 35		6	E. 5	-1.1	E. 14
May	9	E. 3	.	W. 34	Nov.	11	E. 9	-0.8	E. 15
	14	W. 7	+4.6	W. 32		16	E. 12	-0.5	E. 16
	19	W. 15	+2.7	W. 31		21	E. 14	-0.4	E. 17
	24	W. 21	+1.6	W. 30		26	E. 17	-0.3	E. 19
	29	W. 24	+1.0	W. 29		31	E. 19	-0.3	E. 20
June	4	W. 26	+0.6	W. 28	Dec.	5	E. 21	-0.3	E. 21
	9	W. 27	+0.3	W. 27		10	E. 22	-0.3	E. 22
	14	W. 26	+0.1	W. 25		15	E. 23	-0.3	E. 23
	19	W. 24	-0.1	W. 24		20	E. 22	-0.2	E. 25
	24	W. 21	-0.4	W. 23		25	E. 18	+0.5	E. 26
July	29	W. 17	-0.7	W. 21	Jan.	30	E. 10	+2.6	E. 27
	3	W. 12	-1.1	W. 20		5	W. 2	.	E. 28
	8	W. 6	-1.7	W. 19		10	W. 12	+1.7	E. 29
	13	E. 1	-2.4	W. 18		15	W. 19	+0.1	E. 30
	18	E. 6	-1.7	W. 16		20	W. 21	-0.4	E. 31
Aug.	23	E. 12	-1.1	W. 15	Feb.	25	W. 22	-0.4	E. 32
	28	E. 17	-0.7	W. 14		30	W. 21	-0.4	E. 33
	3	E. 21	-0.4	W. 12		35	W. 19	-0.4	E. 35
	8	E. 24	-0.1	W. 11		3	E. 21	-0.4	W. 12
	13	E. 26	+0.1	W. 9		8	E. 24	-0.1	W. 11

MINOR PLANETS

		Stationary	Opposition	Stationary	Conjunction
Ceres	...	Aug. 1	Sept. 16	Nov. 12	| Jan. 31
Pallas	...	May 25	July 29	Sept. 16	—
Juno	...	Jan. 22	Mar. 12	Apr. 29	Oct. 23
Vesta	...	June 24	Aug. 5	Sept. 18	—

ELONGATIONS AND MAGNITUDES OF PLANETS AND PLUTO AT 0^h UT

Date		Mars		Jupiter		Saturn		Uranus	Neptune	Pluto			
		Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Elong.	Elong.			
Jan.	-1	E.	9 +1.2	E.	78 -2.4	W.	82 +0.8	E.	79	E.	49	W.	5
	9	E.	6 +1.2	E.	69 -2.3	W.	91 +0.8	E.	69	E.	39	W.	14
	19	E.	4 +1.1	E.	61 -2.2	W.	101 +0.7	E.	59	E.	29	W.	23
	29	E.	2 +1.1	E.	52 -2.2	W.	111 +0.7	E.	49	E.	19	W.	33
Feb.	8	W.	1 +1.1	E.	44 -2.1	W.	122 +0.6	E.	39	E.	9	W.	42
Mar.	18	W.	3 +1.1	E.	36 -2.1	W.	132 +0.6	E.	30	W.	1	W.	52
	28	W.	5 +1.1	E.	29 -2.1	W.	143 +0.5	E.	20	W.	10	W.	62
	10	W.	7 +1.1	E.	21 -2.1	W.	153 +0.5	E.	11	W.	20	W.	72
	20	W.	9 +1.2	E.	13 -2.1	W.	164 +0.4	E.	2	W.	30	W.	82
	30	W.	11 +1.2	E.	6 -2.1	W.	174 +0.4	W.	8	W.	39	W.	91
Apr.	9	W.	14 +1.2	W.	2 -2.1	E.	174 +0.4	W.	17	W.	49	W.	101
	19	W.	16 +1.2	W.	9 -2.1	E.	164 +0.4	W.	26	W.	58	W.	111
	29	W.	18 +1.2	W.	17 -2.1	E.	154 +0.5	W.	36	W.	68	W.	121
May	9	W.	20 +1.3	W.	24 -2.1	E.	143 +0.6	W.	45	W.	77	W.	131
	19	W.	22 +1.3	W.	31 -2.1	E.	133 +0.7	W.	54	W.	87	W.	140
June	29	W.	24 +1.3	W.	39 -2.1	E.	123 +0.7	W.	63	W.	96	W.	150
	8	W.	26 +1.3	W.	46 -2.1	E.	114 +0.8	W.	73	W.	106	W.	160
	18	W.	29 +1.4	W.	54 -2.2	E.	104 +0.8	W.	82	W.	116	W.	169
	28	W.	31 +1.4	W.	62 -2.2	E.	95 +0.9	W.	91	W.	125	W.	176
July	8	W.	34 +1.4	W.	70 -2.3	E.	85 +0.9	W.	101	W.	135	E.	169
Aug.	18	W.	36 +1.4	W.	78 -2.3	E.	76 +0.9	W.	111	W.	145	E.	160
	28	W.	39 +1.4	W.	86 -2.4	E.	67 +0.9	W.	120	W.	154	E.	151
	7	W.	42 +1.4	W.	95 -2.5	E.	59 +0.9	W.	130	W.	164	E.	141
	17	W.	45 +1.4	W.	104 -2.5	E.	50 +0.9	W.	140	W.	174	E.	131
	27	W.	48 +1.4	W.	113 -2.6	E.	41 +0.9	W.	150	E.	176	E.	121
Sept.	6	W.	51 +1.4	W.	123 -2.7	E.	33 +0.9	W.	160	E.	166	E.	112
	16	W.	55 +1.4	W.	133 -2.8	E.	24 +0.8	W.	170	E.	156	E.	102
	26	W.	58 +1.3	W.	143 -2.8	E.	16 +0.8	W.	179	E.	146	E.	92
Oct.	6	W.	62 +1.3	W.	154 -2.9	E.	7 +0.8	E.	170	E.	136	E.	83
	16	W.	66 +1.2	W.	165 -2.9	W.	3 +0.7	E.	160	E.	126	E.	73
Nov.	26	W.	71 +1.1	W.	176 -2.9	W.	11 +0.7	E.	149	E.	116	E.	63
	5	W.	75 +1.1	E.	172 -2.9	W.	19 +0.7	E.	139	E.	106	E.	53
	15	W.	80 +1.0	E.	161 -2.9	W.	28 +0.8	E.	129	E.	96	E.	44
	25	W.	86 +0.8	E.	150 -2.8	W.	37 +0.8	E.	118	E.	86	E.	34
Dec.	5	W.	91 +0.7	E.	139 -2.8	W.	46 +0.7	E.	108	E.	76	E.	24
	15	W.	98 +0.5	E.	128 -2.7	W.	56 +0.7	E.	98	E.	66	E.	15
	25	W.	105 +0.3	E.	118 -2.6	W.	65 +0.7	E.	88	E.	56	E.	6
	35	W.	112 +0.1	E.	107 -2.6	W.	75 +0.7	E.	78	E.	46	W.	7

Magnitudes at opposition: Uranus 5.7 Neptune 7.8 Pluto 14.0

VISUAL MAGNITUDES OF MINOR PLANETS

	Jan. 9	Feb. 18	Mar. 30	May 9	June 18	July 28	Sept. 6	Oct. 16	Nov. 25	Dec. 35
Ceres	9.1	9.1	9.3	9.3	9.0	8.4	7.7	8.1	8.7	9.1
Pallas	10.4	10.5	10.5	10.2	9.9	9.5	9.8	10.2	10.5	10.5
Juno	9.9	9.3	9.4	10.2	10.9	11.2	11.3	11.2	11.4	11.5
Vesta	7.8	7.8	7.6	7.2	6.5	5.7	6.4	7.2	7.8	8.1

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h			d	h		
June	3	15	Neptune stationary		Aug.	18	16	Moon at apogee
	9	02	FIRST QUARTER			20	12	Jupiter 5° S. of Moon
	10	21	Saturn 8° N. of Moon			21	22	LAST QUARTER
	12	02	Moon at perigee			22	23	Neptune at opposition
	13	00	Mercury in superior conjunction			25	14	Mars 3° N. of Moon
	14	05	Saturn stationary			26	04	Mercury stationary
	15	20	FULL MOON	Eclipse		28	01	Mercury 3° N. of Moon
	18	08	Venus 5° N. of <i>Aldebaran</i>			29	03	NEW MOON
	21	02	Neptune 6° S. of Moon			30	17	Jupiter stationary
	21	17	Solstice			30	18	Moon at perigee
	23	12	LAST QUARTER			31	23	Saturn 7° N. of Moon
	23	23	Uranus 6° S. of Moon		Sept.	3	06	Mercury greatest elong. W. (18°)
	24	04	Moon at apogee			4	18	FIRST QUARTER
	24	19	Vesta stationary			9	02	Mercury 0°7' N. of <i>Regulus</i>
	26	09	Jupiter 5° S. of Moon			10	02	Mars 6° S. of <i>Pollux</i>
	28	05	Pluto at opposition			10	21	Neptune 6° S. of Moon
	28	19	Mars 1°7' S. of Moon			12	09	FULL MOON
	28	22	Mercury 5° S. of <i>Pollux</i>			13	18	Uranus 6° S. of Moon
July	1	09	NEW MOON	Eclipse		15	06	Moon at apogee
	3	02	Mercury 5° N. of Moon			16	12	Pluto stationary
	4	15	Earth at aphelion			16	17	Ceres at opposition
	6	07	Mars 5° N. of <i>Aldebaran</i>			16	18	Jupiter 5° S. of Moon
	7	14	Moon at perigee			16	22	Pallas stationary
	8	04	Saturn 8° N. of Moon			18	02	Vesta stationary
	8	06	FIRST QUARTER			20	14	LAST QUARTER
	10	08	Uranus stationary			23	08	Mars 5° N. of Moon
	15	07	FULL MOON			23	09	Equinox
	18	10	Neptune 6° S. of Moon			26	00	Uranus at opposition
	20	05	Mercury greatest elong. E. (27°)			27	11	NEW MOON
	21	07	Uranus 6° S. of Moon			28	01	Moon at perigee
	21	23	Moon at apogee			28	20	Mercury in superior conjunction
	23	05	LAST QUARTER		Oct.	3	12	Venus 3° N. of <i>Spica</i>
	24	01	Jupiter 5° S. of Moon			4	03	FIRST QUARTER
	27	17	Mars 0°5' N. of Moon	Occn.		8	02	Neptune 6° S. of Moon
	29	14	Pallas at opposition			10	22	Uranus 6° S. of Moon
	30	19	NEW MOON			12	02	FULL MOON
Aug.	1	00	Ceres stationary			12	12	Moon at apogee
	1	11	Mercury 1°5' N. of Moon			13	20	Jupiter 5° S. of Moon
	2	07	Mercury stationary			13	21	Saturn in conjunction with Sun
	2	21	Moon at perigee			20	04	LAST QUARTER
	4	12	Saturn 8° N. of Moon			22	00	Mars 6° N. of Moon
	5	10	Vesta at opposition			23	01	Juno in conjunction with Sun
	6	11	FIRST QUARTER			26	12	Moon at perigee
	13	19	FULL MOON			26	20	NEW MOON
	14	16	Neptune 6° S. of Moon			28	02	Mercury 0°2' N. of Moon Occn.
	16	12	Venus in superior conjunction			28	05	Venus 1°8' N. of Moon
	17	01	Mercury in inferior conjunction			29	02	Jupiter at opposition
	17	13	Uranus 6° S. of Moon			31	05	Saturn 5° N. of <i>Spica</i>

CONFIGURATIONS OF SUN, MOON AND PLANETS

d h		d h	
Nov. 2 17	FIRST QUARTER	Dec. 2 10	FIRST QUARTER
4 08	Neptune 6° S. of Moon	4 08	Uranus 6° S. of Moon
7 02	Uranus 6° S. of Moon	4 09	Mercury in inferior conjunction
8 13	Moon at apogee	6 01	Moon at apogee
9 19	Jupiter 5° S. of Moon	6 20	Jupiter 5° S. of Moon
9 21	Neptune stationary	10 15	FULL MOON
9 21	Venus 4° N. of <i>Antares</i>		Eclipse
10 05	Mars 1°4 N. of <i>Regulus</i>	10 15	Uranus stationary
10 05	Mercury 1°9 N. of <i>Antares</i>	14 02	Mercury stationary
10 20	FULL MOON	17 13	Mars 8° N. of Moon
12 06	Ceres stationary	18 01	LAST QUARTER
14 09	Mercury greatest elong. E. (23°)	20 10	Saturn 7° N. of Moon
18 15	LAST QUARTER	22 03	Moon at perigee
19 10	Mars 8° N. of Moon	22 06	Solstice
22 22	Saturn 7° N. of Moon	22 20	Mercury 7° N. of <i>Antares</i>
23 23	Moon at perigee	23 03	Mercury greatest elong. W. (22°)
24 10	Mercury stationary	23 04	Mercury 3° N. of Moon
25 06	NEW MOON	24 18	NEW MOON
	Eclipse	26 11	Jupiter stationary
26 10	Mercury 1°7 S. of Moon	27 11	Venus 6° S. of Moon
27 04	Venus 3° S. of Moon	29 01	Neptune 6° S. of Moon
Dec. 1 15	Neptune 6° S. of Moon	29 08	Pluto in conjunction with Sun
		31 16	Uranus 6° S. of Moon

PREDICTED PERIHELION PASSAGES OF COMETS, 2011

Periodic comet	Perihelion date	Period distance	Periodic comet	Perihelion date	Period distance
	<i>T</i>	<i>q</i> <i>P</i>		<i>T</i>	<i>q</i> <i>P</i>
		au years			au years
9P/Tempel	Jan. 12	1.51 5.5	P/1999 R1 (SOHO)	Sept. 7	0.05 4.0
P/2003 S2 (NEAT)	Mar. 3	2.46 7.5	45P/Honda-Mrkos-Pajdušáková	Sept. 28	0.53 5.2
P/2005 U1 (Read)	Mar. 10	2.36 5.6	48P/Johnson	Sept. 29	2.30 6.9
P/2006 U1 (LINEAR)	Apr. 15	0.51 4.6	115P/Maury	Oct. 6	2.04 8.8
P/2004 T1 (LINEAR-NEAT)	Apr. 24	1.71 6.5	73P/Schwassmann-Wachmann C	Oct. 16	0.94 5.4
P/2003 CP ₇ (LINEAR-NEAT)	May 17	3.03 8.1	49P/Arend-Rigaux	Oct. 19	1.42 6.7
164P/Christensen	June 2	1.68 7.0	P/1996 R2 (Lagerkvist)	Oct. 19	2.61 7.4
P/2005 R2 (Van Ness)	June 16	2.12 6.3	41P/Tuttle-Giacobini-Kresák	Nov. 12	1.05 5.4
130P/McNaught-Hughes	June 24	2.10 6.6	P/2004 H3 (Larsen)	Nov. 23	2.45 7.7
62P/Tsuchinshan	June 30	1.38 6.4	P/2004 R3 (LINEAR-NEAT)	Nov. 28	2.13 7.5
123P/West-Hartley	July 4	2.13 7.6	37P/Forbes	Dec. 11	1.58 6.4
69P/Taylor	July 17	2.27 7.6	71P/Clark	Dec. 15	1.57 5.5
27P/Crommelin	Aug. 3	0.75 27.9	36P/Whipple	Dec. 30	3.09 8.5
97P/Metcalf-Brewington	Aug. 21	2.60 10.5			
P/2001 YX ₁₂₇ (LINEAR)	Aug. 24	3.43 8.5			

CHRONOLOGICAL CYCLES AND ERAS

Dominical Letter	...	B	Julian Period (year of)	...	6724
Epact	...	25'	Roman Indiction	...	4
Golden Number (Lunar Cycle)	...	XVII	Solar Cycle	...	4

Second Epact 25' to be used as if it were 26.

All dates are given in terms of the Gregorian calendar in which
2011 January 14 corresponds to 2011 January 1 of the Julian calendar.

ERA	YEAR	BEGINS	ERA	YEAR	BEGINS
Byzantine	...	7520 Sept. 14	Japanese	...	2671 Jan. 1
Jewish (A.M.)*	...	5772 Sept. 28	Grecian (Seleucidæ)	...	2323 Sept. 14
Chinese (xīn mǎo)	...	Feb. 3			(or Oct. 14)
Roman (A.U.C.)	...	2764 Jan. 14	Indian (Saka)	...	1933 Mar. 22
Nabonassar	...	2760 Apr. 21	Diocletian	...	1728 Sept. 12
			Islamic (Hegira)*	...	1433 Nov. 26

* Year begins at sunset

RELIGIOUS CALENDARS

Epiphany	...	Jan. 6	Ascension Day	...	June 2
Ash Wednesday	...	Mar. 9	Whit Sunday—Pentecost	...	June 12
Palm Sunday	...	Apr. 17	Trinity Sunday	...	June 19
Good Friday	...	Apr. 22	First Sunday in Advent	...	Nov. 27
Easter Day	...	Apr. 24	Christmas Day (Sunday)	...	Dec. 25
First Day of Passover (Pesach)	...	Apr. 19	Day of Atonement (Yom Kippur)	...	Oct. 8
Feast of Weeks (Shavuot)	...	June 8	First day of Tabernacles		
Jewish New Year (tabular)			(Succoth)	...	Oct. 13
(Rosh Hashanah)	...	Sept. 29	Festival of Lights (Hanukkah)	...	Dec. 21
First day of Ramadân	...	Aug. 1	Islamic New Year	...	Nov. 27
(tabular)			(tabular)		

The Jewish and Islamic dates above are tabular dates, which begin at sunset on the previous evening and end at sunset on the date tabulated. In practice, the dates of Islamic fasts and festivals are determined by an actual sighting of the appropriate new Moon.

CIVIL CALENDAR—UNITED STATES OF AMERICA

New Year's Day	...	Jan. 1	Labor Day	...	Sept. 5
Martin Luther King's Birthday	...	Jan. 17	Columbus Day	...	Oct. 10
Washington's Birthday	...	Feb. 21	Election Day (in certain States)	...	Nov. 8
Memorial Day	...	May 30	Veterans Day	...	Nov. 11
Independence Day	...	July 4	Thanksgiving Day	...	Nov. 24

CIVIL CALENDAR—UNITED KINGDOM

Accession of Queen Elizabeth II	...	Feb. 6	Birthday of Prince Philip,		
St David (Wales)	...	Mar. 1	Duke of Edinburgh	...	June 10
Commonwealth Day	...	Mar. 14	The Queen's Official Birthday†	...	June 11
St Patrick (Ireland)	...	Mar. 17	Remembrance Sunday	...	Nov. 13
Birthday of Queen Elizabeth II	...	Apr. 21	Birthday of the Prince of Wales	...	Nov. 14
St George (England)	...	Apr. 23	St Andrew (Scotland)	...	Nov. 30
Coronation Day	...	June 2			

†Date subject to confirmation

CALENDAR, 2011

	JANUARY			FEBRUARY			MARCH			APRIL			MAY			JUNE		
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Sat.	1	Tue.	32	Tue.	60	Fri.	91	Sun.	121	Wed.	152						
2	Sun.	2	Wed.	33	Wed.	61	Sat.	92	Mon.	122	Thu.	153						
3	Mon.	3	Thu.	34	Thu.	62	Sun.	93	Tue.	123	Fri.	154						
4	Tue.	4	Fri.	35	Fri.	63	Mon.	94	Wed.	124	Sat.	155						
5	Wed.	5	Sat.	36	Sat.	64	Tue.	95	Thu.	125	Sun.	156						
6	Thu.	6	Sun.	37	Sun.	65	Wed.	96	Fri.	126	Mon.	157						
7	Fri.	7	Mon.	38	Mon.	66	Thu.	97	Sat.	127	Tue.	158						
8	Sat.	8	Tue.	39	Tue.	67	Fri.	98	Sun.	128	Wed.	159						
9	Sun.	9	Wed.	40	Wed.	68	Sat.	99	Mon.	129	Thu.	160						
10	Mon.	10	Thu.	41	Thu.	69	Sun.	100	Tue.	130	Fri.	161						
11	Tue.	11	Fri.	42	Fri.	70	Mon.	101	Wed.	131	Sat.	162						
12	Wed.	12	Sat.	43	Sat.	71	Tue.	102	Thu.	132	Sun.	163						
13	Thu.	13	Sun.	44	Sun.	72	Wed.	103	Fri.	133	Mon.	164						
14	Fri.	14	Mon.	45	Mon.	73	Thu.	104	Sat.	134	Tue.	165						
15	Sat.	15	Tue.	46	Tue.	74	Fri.	105	Sun.	135	Wed.	166						
16	Sun.	16	Wed.	47	Wed.	75	Sat.	106	Mon.	136	Thu.	167						
17	Mon.	17	Thu.	48	Thu.	76	Sun.	107	Tue.	137	Fri.	168						
18	Tue.	18	Fri.	49	Fri.	77	Mon.	108	Wed.	138	Sat.	169						
19	Wed.	19	Sat.	50	Sat.	78	Tue.	109	Thu.	139	Sun.	170						
20	Thu.	20	Sun.	51	Sun.	79	Wed.	110	Fri.	140	Mon.	171						
21	Fri.	21	Mon.	52	Mon.	80	Thu.	111	Sat.	141	Tue.	172						
22	Sat.	22	Tue.	53	Tue.	81	Fri.	112	Sun.	142	Wed.	173						
23	Sun.	23	Wed.	54	Wed.	82	Sat.	113	Mon.	143	Thu.	174						
24	Mon.	24	Thu.	55	Thu.	83	Sun.	114	Tue.	144	Fri.	175						
25	Tue.	25	Fri.	56	Fri.	84	Mon.	115	Wed.	145	Sat.	176						
26	Wed.	26	Sat.	57	Sat.	85	Tue.	116	Thu.	146	Sun.	177						
27	Thu.	27	Sun.	58	Sun.	86	Wed.	117	Fri.	147	Mon.	178						
28	Fri.	28	Mon.	59	Mon.	87	Thu.	118	Sat.	148	Tue.	179						
29	Sat.	29			Tue.	88	Fri.	119	Sun.	149	Wed.	180						
30	Sun.	30			Wed.	89	Sat.	120	Mon.	150	Thu.	181						
31	Mon.	31			Thu.	90			Tue.	151								

JULIAN DATE, 2011

0 ^h UT	JD	0 ^h UT	JD	0 ^h UT	JD
Jan. 0	245 5561.5	May 0	245 5681.5	Sept. 0	245 5804.5
Feb. 0	245 5592.5	June 0	245 5712.5	Oct. 0	245 5834.5
Mar. 0	245 5620.5	July 0	245 5742.5	Nov. 0	245 5865.5
Apr. 0	245 5651.5	Aug. 0	245 5773.5	Dec. 0	245 5895.5

400-day date, JD 245 5600.5 = 2011 February 8.0

Standard epoch, 1900 January 0, 12^h UT = JD 241 5020.0

Standard epoch, B1950.0 = 1950 Jan. 0.923 = JD 243 3282.423

B2011.0 = 2011 Jan. 0.698 = JD 245 5562.198

Standard epoch, J2000.0 = 2000 Jan. 1.5 = JD 245 1545.0

J2011.5 = 2011 July 2.875 = JD 245 5745.375

JULY			AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Fri.	182	Mon.	213	Thu.	244	Sat.	274	Tue.	305	Thu.	335
2	Sat.	183	Tue.	214	Fri.	245	Sun.	275	Wed.	306	Fri.	336
3	Sun.	184	Wed.	215	Sat.	246	Mon.	276	Thu.	307	Sat.	337
4	Mon.	185	Thu.	216	Sun.	247	Tue.	277	Fri.	308	Sun.	338
5	Tue.	186	Fri.	217	Mon.	248	Wed.	278	Sat.	309	Mon.	339
6	Wed.	187	Sat.	218	Tue.	249	Thu.	279	Sun.	310	Tue.	340
7	Thu.	188	Sun.	219	Wed.	250	Fri.	280	Mon.	311	Wed.	341
8	Fri.	189	Mon.	220	Thu.	251	Sat.	281	Tue.	312	Thu.	342
9	Sat.	190	Tue.	221	Fri.	252	Sun.	282	Wed.	313	Fri.	343
10	Sun.	191	Wed.	222	Sat.	253	Mon.	283	Thu.	314	Sat.	344
11	Mon.	192	Thu.	223	Sun.	254	Tue.	284	Fri.	315	Sun.	345
12	Tue.	193	Fri.	224	Mon.	255	Wed.	285	Sat.	316	Mon.	346
13	Wed.	194	Sat.	225	Tue.	256	Thu.	286	Sun.	317	Tue.	347
14	Thu.	195	Sun.	226	Wed.	257	Fri.	287	Mon.	318	Wed.	348
15	Fri.	196	Mon.	227	Thu.	258	Sat.	288	Tue.	319	Thu.	349
16	Sat.	197	Tue.	228	Fri.	259	Sun.	289	Wed.	320	Fri.	350
17	Sun.	198	Wed.	229	Sat.	260	Mon.	290	Thu.	321	Sat.	351
18	Mon.	199	Thu.	230	Sun.	261	Tue.	291	Fri.	322	Sun.	352
19	Tue.	200	Fri.	231	Mon.	262	Wed.	292	Sat.	323	Mon.	353
20	Wed.	201	Sat.	232	Tue.	263	Thu.	293	Sun.	324	Tue.	354
21	Thu.	202	Sun.	233	Wed.	264	Fri.	294	Mon.	325	Wed.	355
22	Fri.	203	Mon.	234	Thu.	265	Sat.	295	Tue.	326	Thu.	356
23	Sat.	204	Tue.	235	Fri.	266	Sun.	296	Wed.	327	Fri.	357
24	Sun.	205	Wed.	236	Sat.	267	Mon.	297	Thu.	328	Sat.	358
25	Mon.	206	Thu.	237	Sun.	268	Tue.	298	Fri.	329	Sun.	359
26	Tue.	207	Fri.	238	Mon.	269	Wed.	299	Sat.	330	Mon.	360
27	Wed.	208	Sat.	239	Tue.	270	Thu.	300	Sun.	331	Tue.	361
28	Thu.	209	Sun.	240	Wed.	271	Fri.	301	Mon.	332	Wed.	362
29	Fri.	210	Mon.	241	Thu.	272	Sat.	302	Tue.	333	Thu.	363
30	Sat.	211	Tue.	242	Fri.	273	Sun.	303	Wed.	334	Fri.	364
31	Sun.	212	Wed.	243			Mon.	304			Sat.	365

MEAN SIDEREAL TIME, 2011

Greenwich mean sidereal time at 0^h UT

	h		h		h		h
Jan. 0	6-6209	Apr. 0	12-5348	July 0	18-5144	Oct. 0	0-5597
Feb. 0	8-6579	May 0	14-5061	Aug. 0	20-5514	Nov. 0	2-5967
Mar. 0	10-4978	June 0	16-5431	Sept. 0	22-5884	Dec. 0	4-5680

Greenwich mean sidereal time (GMST) on day d of month at hour t UT

$$= \text{GMST at } 0^{\text{h}} \text{ UT on day } 0 + 0^{\text{h}}065\,71\,d + 1^{\text{h}}002\,74\,t$$

$$\text{Local mean sidereal time} = \text{GMST} \begin{matrix} + \text{east} \\ - \text{west} \end{matrix} \text{ longitude}$$

AT 0^h UNIVERSAL TIME

Equation Declin-			Equation Declin-			Equation Declin-			Equation Declin-		
Date	of time	ation	Date	of time	ation	Date	of time	ation	Date	of time	ation
Jan. 0			Feb. 15			Apr. 1			May 17		
	^m _s	[°] _'		^m _s	[°] _'		^m _s	[°] _'		^m _s	[°] _'
1	03 11	23 03	16	14 06	12 32	2	03 49	04 43	18	03 36	19 26
2	03 39	22 58	17	14 03	12 11	3	03 31	05 06	19	03 34	19 39
3	04 07	22 52	18	13 58	11 50	4	03 14	05 29	20	03 31	19 52
4	04 35	22 47	19	13 53	11 29	5	02 57	05 51	21	03 28	20 04
5	-05 02	-22 40	20	-13 48	-11 07	6	-02 39	+06 14	22	+03 24	+20 16
6	05 29	22 34	21	13 41	10 46	7	02 22	06 37	23	03 19	20 28
7	05 56	22 26	22	13 34	10 24	8	02 06	07 00	24	03 14	20 40
8	06 22	22 19	23	13 27	10 02	9	01 49	07 22	25	03 09	20 51
9	06 47	22 11	24	13 18	09 40	10	01 33	07 44	26	03 03	21 02
10	-07 12	-22 02	25	-13 10	-09 18	11	-01 17	+08 07	27	+02 56	+21 12
11	07 37	21 53	26	13 00	08 56	12	01 01	08 29	28	02 50	21 22
12	08 00	21 44	27	12 50	08 33	13	00 45	08 50	29	02 42	21 32
13	08 24	21 34	28	12 40	08 11	14	00 30	09 12	30	02 34	21 41
14	08 46	21 24	Mar. 1	12 29	07 48	15	-00 15	09 34	31	02 26	21 50
15	-09 08	-21 13	2	-12 17	-07 25	16	00 00	+09 55	June 1	+02 17	+21 59
16	09 29	21 02	3	12 05	07 02	17	+00 14	10 17	2	02 08	22 07
17	09 50	20 51	4	11 53	06 39	18	00 28	10 38	3	01 58	22 14
18	10 09	20 39	5	11 40	06 16	19	00 41	10 59	4	01 48	22 22
19	10 28	20 27	6	11 27	05 53	20	00 55	11 19	5	01 38	22 29
20	-10 47	-20 14	7	-11 13	-05 30	21	+01 07	+11 40	6	+01 27	+22 35
21	11 04	20 02	8	10 59	05 06	22	01 20	12 00	7	01 16	22 42
22	11 21	19 48	9	10 44	04 43	23	01 31	12 21	8	01 05	22 48
23	11 37	19 34	10	10 29	04 20	24	01 43	12 41	9	00 54	22 53
24	11 53	19 20	11	10 14	03 56	25	01 54	13 00	10	00 42	22 58
25	-12 07	-19 06	12	-09 58	-03 33	26	+02 04	+13 20	11	+00 30	+23 03
26	12 21	18 51	13	09 42	03 09	27	02 14	13 39	12	00 18	23 07
27	12 34	18 36	14	09 26	02 45	28	02 23	13 58	13	+00 06	23 11
28	12 46	18 21	15	09 09	02 22	29	02 32	14 17	14	-00 07	23 14
29	12 58	18 05	16	08 53	01 58	30	02 40	14 36	15	00 19	23 17
30	-13 08	-17 49	17	-08 36	-01 34	May 1	+02 48	+14 54	16	-00 32	+23 19
31	13 18	17 32	18	08 18	01 11	2	02 55	15 13	17	00 45	23 22
Feb. 1	13 27	17 16	19	08 01	00 47	3	03 02	15 30	18	00 58	23 23
2	13 36	16 58	20	07 43	-00 23	4	03 08	15 48	19	01 11	23 25
3	13 43	16 41	21	07 25	+00 01	5	03 14	16 06	20	01 24	23 26
4	-13 50	-16 23	22	-07 07	+00 24	6	+03 19	+16 23	21	-01 37	+23 26
5	13 55	16 06	23	06 49	00 48	7	03 23	16 40	22	01 50	23 26
6	14 00	15 47	24	06 31	01 12	8	03 27	16 56	23	02 03	23 26
7	14 04	15 29	25	06 13	01 35	9	03 30	17 12	24	02 16	23 25
8	14 08	15 10	26	05 55	01 59	10	03 33	17 28	25	02 28	23 24
9	-14 10	-14 51	27	-05 37	+02 22	11	+03 35	+17 44	26	-02 41	+23 22
10	14 12	14 32	28	05 19	02 46	12	03 37	18 00	27	02 54	23 20
11	14 13	14 12	29	05 01	03 09	13	03 38	18 15	28	03 06	23 18
12	14 13	13 53	30	04 43	03 33	14	03 39	18 29	29	03 19	23 15
13	14 13	13 33	31	04 25	03 56	15	03 39	18 44	30	03 31	23 12
14	-14 11	-13 13	Apr. 1	-04 07	+04 19	16	+03 38	+18 58	July 1	-03 43	+23 08
15	-14 09	-12 52	2	-03 49	+04 43	17	+03 37	+19 12	2	-03 55	+23 04

Equation of time = apparent time - mean time

AT 0^h UNIVERSAL TIME

Equation Date of time	Declina- tion	Equation Date of time	Declina- tion	Equation Date of time	Declina- tion	Equation Date of time	Declina- tion
^m ^s	[°] [']	^m ^s	[°] [']	^m ^s	[°] [']	^m ^s	[°] [']
July 1	-03 43 +23 08	Aug. 16	-04 27 +13 55	Oct. 1	+10 04 -02 58	Nov. 16	+15 23 -18 35
2	03 55 23 04	17	04 14 13 36	2	10 24 03 21	17	15 13 18 50
3	04 06 23 00	18	04 02 13 17	3	10 43 03 45	18	15 01 19 05
4	04 17 22 55	19	03 48 12 57	4	11 02 04 08	19	14 49 19 19
5	04 28 22 50	20	03 34 12 38	5	11 20 04 31	20	14 35 19 33
6	-04 39 +22 44	21	-03 20 +12 18	6	+11 38 -04 54	21	+14 21 -19 47
7	04 49 22 38	22	03 05 11 58	7	11 56 05 17	22	14 06 20 00
8	04 58 22 32	23	02 50 11 38	8	12 13 05 40	23	13 50 20 13
9	05 08 22 25	24	02 34 11 18	9	12 30 06 03	24	13 34 20 26
10	05 17 22 18	25	02 18 10 57	10	12 47 06 26	25	13 16 20 38
11	-05 25 +22 10	26	-02 02 +10 36	11	+13 03 -06 48	26	+12 58 -20 50
12	05 33 22 03	27	01 45 10 15	12	13 19 07 11	27	12 39 21 01
13	05 41 21 54	28	01 28 09 54	13	13 34 07 33	28	12 20 21 12
14	05 48 21 46	29	01 10 09 33	14	13 49 07 56	29	11 59 21 23
15	05 54 21 36	30	00 53 09 12	15	14 03 08 18	30	11 38 21 33
16	-06 00 +21 27	31	-00 34 +08 50	16	+14 16 -08 40	Dec. 1	+11 17 -21 42
17	06 06 21 17	Sept. 1	-00 16 08 29	17	14 29 09 02	2	10 54 21 52
18	06 11 21 07	2	+00 03 08 07	18	14 42 09 24	3	10 32 22 01
19	06 15 20 57	3	00 22 07 45	19	14 53 09 46	4	10 08 22 09
20	06 19 20 46	4	00 42 07 23	20	15 04 10 08	5	09 44 22 17
21	-06 23 +20 35	5	+01 02 +07 01	21	+15 15 -10 29	6	+09 19 -22 25
22	06 26 20 23	6	01 22 06 39	22	15 25 10 51	7	08 54 22 32
23	06 28 20 11	7	01 42 06 17	23	15 34 11 12	8	08 28 22 39
24	06 30 19 59	8	02 03 05 54	24	15 42 11 33	9	08 02 22 45
25	06 31 19 46	9	02 23 05 32	25	15 50 11 54	10	07 36 22 51
26	-06 32 +19 33	10	+02 44 +05 09	26	+15 57 -12 15	11	+07 09 -22 57
27	06 32 19 20	11	03 05 04 46	27	16 03 12 35	12	06 41 23 02
28	06 31 19 07	12	03 26 04 23	28	16 09 12 55	13	06 13 23 06
29	06 30 18 53	13	03 48 04 01	29	16 13 13 16	14	05 45 23 10
30	06 29 18 38	14	04 09 03 38	30	16 17 13 35	15	05 17 23 14
31	-06 26 +18 24	15	+04 30 +03 15	31	+16 21 -13 55	16	+04 48 -23 17
Aug. 1	06 23 18 09	16	04 52 02 52	Nov. 1	16 23 14 15	17	04 19 23 20
2	06 20 17 54	17	05 13 02 28	2	16 25 14 34	18	03 50 23 22
3	06 16 17 39	18	05 35 02 05	3	16 26 14 53	19	03 20 23 24
4	06 11 17 23	19	05 56 01 42	4	16 26 15 12	20	02 51 23 25
5	-06 06 +17 07	20	+06 18 +01 19	5	+16 25 -15 30	21	+02 21 -23 26
6	06 00 16 51	21	06 39 00 55	6	16 24 15 48	22	01 51 23 26
7	05 53 16 34	22	07 00 00 32	7	16 22 16 06	23	01 21 23 26
8	05 46 16 18	23	07 21 +00 09	8	16 18 16 24	24	00 51 23 25
9	05 38 16 01	24	07 42 -00 15	9	16 15 16 41	25	+00 21 23 24
10	-05 29 +15 43	25	+08 03 -00 38	10	+16 10 -16 59	26	-00 09 -23 23
11	05 20 15 26	26	08 24 01 01	11	16 04 17 16	27	00 38 23 21
12	05 11 15 08	27	08 45 01 25	12	15 58 17 32	28	01 08 23 18
13	05 01 14 50	28	09 05 01 48	13	15 50 17 48	29	01 38 23 15
14	04 50 14 32	29	09 25 02 11	14	15 42 18 04	30	02 07 23 12
15	-04 39 +14 13	30	+09 45 -02 35	15	+15 33 -18 20	31	-02 36 -23 08
16	-04 27 +13 55	Oct. 1	+10 04 -02 58	16	+15 23 -18 35	32	-03 05 -23 04

UT of transit = $12^{\text{h}} - \frac{\text{east}}{+ \text{west}}$ longitude - equation of time

AT 0^h UNIVERSAL TIME

Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA
Jan. 0	57° 42'	139° 57'	Feb. 15	103° 21'	185° 19'	Apr. 1	147° 58'	229° 32'	May 17	193° 18'	274° 39'
1	58 41	140 56	16	104 21	186 18	2	148 57	230 31	18	194 17	275 38
2	59 41	141 56	17	105 20	187 17	3	149 57	231 30	19	195 16	276 37
3	60 40	142 55	18	106 20	188 16	4	150 56	232 29	20	196 15	277 36
4	61 40	143 54	19	107 19	189 15	5	151 55	233 28	21	197 14	278 35
5	62 39	144 53	20	108 19	190 14	6	152 54	234 27	22	198 13	279 34
6	63 39	145 53	21	109 19	191 13	7	153 54	235 26	23	199 12	280 32
7	64 38	146 52	22	110 18	192 12	8	154 53	236 24	24	200 11	281 31
8	65 38	147 51	23	111 18	193 11	9	155 52	237 23	25	201 10	282 30
9	66 37	148 50	24	112 17	194 10	10	156 51	238 22	26	202 09	283 29
10	67 37	149 50	25	113 17	195 09	11	157 51	239 21	27	203 08	284 28
11	68 36	150 49	26	114 16	196 08	12	158 50	240 20	28	204 07	285 27
12	69 36	151 48	27	115 16	197 07	13	159 49	241 19	29	205 06	286 26
13	70 35	152 47	28	116 15	198 06	14	160 48	242 17	30	206 04	287 24
14	71 35	153 47	Mar. 1	117 15	199 05	15	161 48	243 16	31	207 03	288 23
15	72 34	154 46	2	118 14	200 04	16	162 47	244 15	June 1	208 02	289 22
16	73 34	155 45	3	119 14	201 03	17	163 46	245 14	2	209 01	290 21
17	74 33	156 44	4	120 14	202 02	18	164 45	246 13	3	210 00	291 20
18	75 33	157 43	5	121 13	203 01	19	165 45	247 12	4	210 58	292 19
19	76 32	158 43	6	122 13	204 00	20	166 44	248 11	5	211 57	293 17
20	77 32	159 42	7	123 12	204 59	21	167 43	249 10	6	212 56	294 16
21	78 32	160 41	8	124 12	205 58	22	168 42	250 08	7	213 55	295 15
22	79 31	161 40	9	125 11	206 57	23	169 41	251 07	8	214 54	296 14
23	80 31	162 39	10	126 11	207 56	24	170 40	252 06	9	215 53	297 13
24	81 30	163 38	11	127 10	208 55	25	171 39	253 05	10	216 52	298 12
25	82 30	164 38	12	128 09	209 54	26	172 39	254 04	11	217 50	299 11
26	83 30	165 37	13	129 09	210 53	27	173 38	255 03	12	218 49	300 10
27	84 29	166 36	14	130 08	211 52	28	174 37	256 01	13	219 48	301 08
28	85 29	167 35	15	131 08	212 51	29	175 36	257 00	14	220 47	302 07
29	86 28	168 34	16	132 07	213 50	30	176 35	257 59	15	221 45	303 06
30	87 28	169 33	17	133 07	214 48	May 1	177 34	258 58	16	222 44	304 05
31	88 27	170 33	18	134 06	215 47	2	178 33	259 57	17	223 43	305 04
Feb. 1	89 27	171 32	19	135 06	216 46	3	179 32	260 56	18	224 41	306 03
2	90 26	172 31	20	136 05	217 45	4	180 31	261 55	19	225 40	307 02
3	91 26	173 30	21	137 05	218 44	5	181 30	262 53	20	226 39	308 00
4	92 26	174 29	22	138 04	219 43	6	182 29	263 52	21	227 38	308 59
5	93 25	175 28	23	139 03	220 42	7	183 28	264 51	22	228 37	309 58
6	94 25	176 27	24	140 03	221 41	8	184 27	265 50	23	229 35	310 57
7	95 25	177 26	25	141 02	222 40	9	185 26	266 49	24	230 34	311 56
8	96 24	178 25	26	142 01	223 39	10	186 26	267 47	25	231 33	312 55
9	97 24	179 24	27	143 01	224 38	11	187 25	268 46	26	232 32	313 54
10	98 23	180 24	28	144 00	225 37	12	188 24	269 45	27	233 30	314 53
11	99 23	181 23	29	145 00	226 35	13	189 23	270 44	28	234 29	315 52
12	100 22	182 22	30	145 59	227 34	14	190 22	271 43	29	235 28	316 51
13	101 22	183 21	31	146 58	228 33	15	191 21	272 42	30	236 26	317 50
14	102 21	184 20	Apr. 1	147 58	229 32	16	192 20	273 41	July 1	237 25	318 49
15	103 21	185 19	2	148 57	230 31	17	193 18	274 39	2	238 24	319 47

The dates between Jan. 0 and Dec. 32 below are the dates when p changes to the next value.

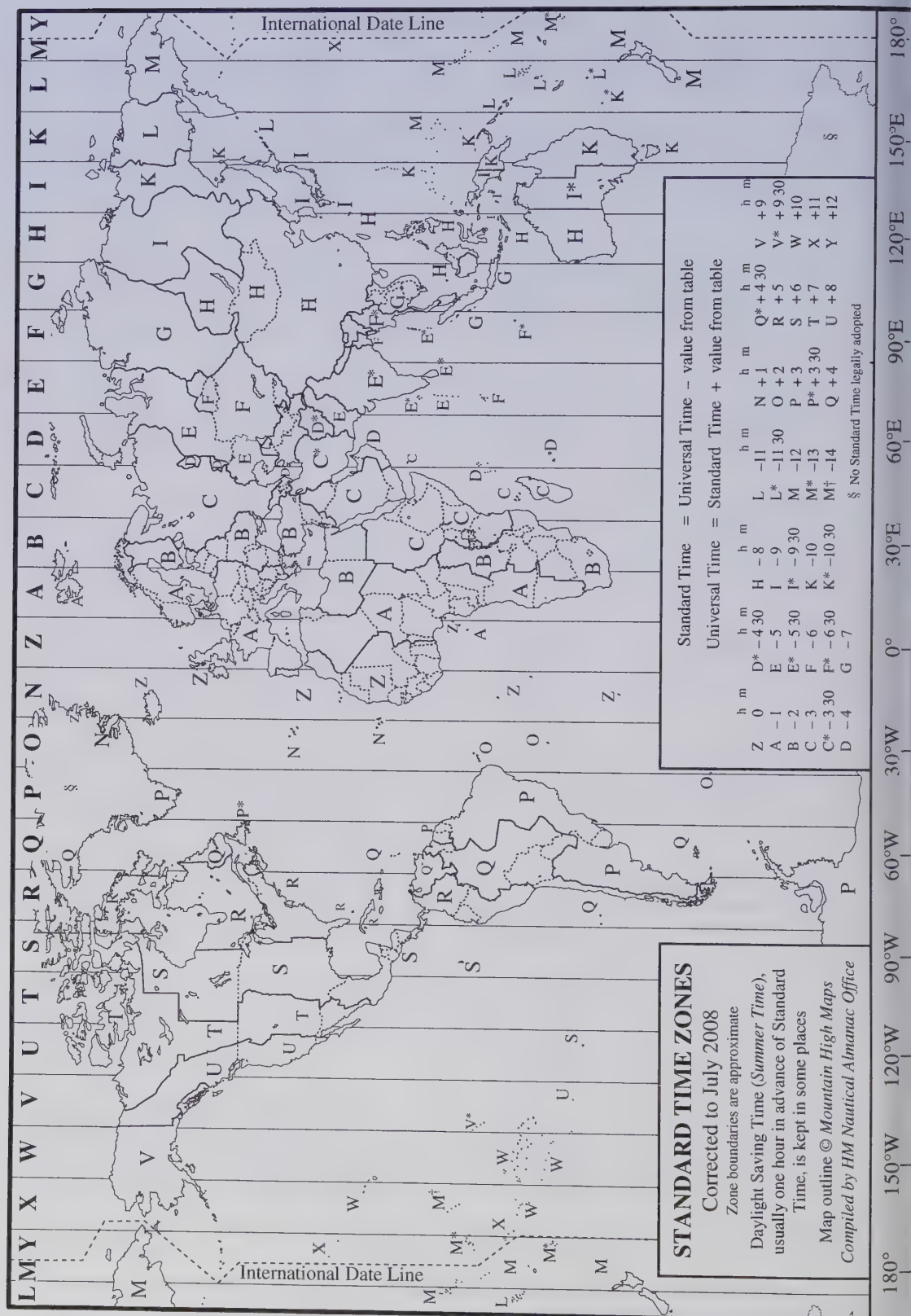
Polar Distance (p) *Polaris*: Jan. 0 41' Dec. 32
 σ Octantis: Jan. 0 65' Feb. 16 66' Sept. 10 65' Dec. 31 66' Dec. 32

AT 0^h UNIVERSAL TIME

Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA
July	1 237 25	318 49	Aug. 16	282 23	4 03	Oct. 1	327 24	49 29	Nov. 16	12 36	95 01
2	238 24	319 47	17	283 22	5 02	2	328 23	50 28	17	13 35	96 01
3	239 22	320 46	18	284 21	6 02	3	329 22	51 27	18	14 35	97 00
4	240 21	321 45	19	285 19	7 01	4	330 21	52 27	19	15 34	97 59
5	241 20	322 44	20	286 18	8 00	5	331 19	53 26	20	16 33	98 59
6	242 19	323 43	21	287 17	8 59	6	332 18	54 25	21	17 32	99 58
7	243 17	324 42	22	288 15	9 58	7	333 17	55 25	22	18 31	100 58
8	244 16	325 41	23	289 14	10 58	8	334 16	56 24	23	19 30	101 57
9	245 15	326 40	24	290 13	11 57	9	335 15	57 23	24	20 30	102 57
10	246 13	327 39	25	291 11	12 56	10	336 14	58 23	25	21 29	103 56
11	247 12	328 38	26	292 10	13 55	11	337 13	59 22	26	22 28	104 55
12	248 10	329 37	27	293 09	14 54	12	338 12	60 22	27	23 27	105 55
13	249 09	330 36	28	294 07	15 53	13	339 10	61 21	28	24 26	106 54
14	250 08	331 35	29	295 06	16 52	14	340 09	62 21	29	25 25	107 54
15	251 06	332 34	30	296 05	17 52	15	341 08	63 20	30	26 25	108 53
16	252 05	333 33	31	297 03	18 51	16	342 07	64 19	Dec. 1	27 24	109 52
17	253 04	334 32	Sept. 1	298 02	19 50	17	343 06	65 19	2	28 23	110 52
18	254 03	335 31	2	299 01	20 49	18	344 05	66 18	3	29 23	111 51
19	255 01	336 30	3	299 59	21 49	19	345 04	67 18	4	30 22	112 50
20	256 00	337 29	4	300 58	22 48	20	346 03	68 17	5	31 21	113 50
21	256 59	338 28	5	301 57	23 47	21	347 02	69 16	6	32 20	114 49
22	257 57	339 27	6	302 55	24 46	22	348 01	70 16	7	33 20	115 49
23	258 56	340 26	7	303 54	25 46	23	349 00	71 15	8	34 19	116 48
24	259 55	341 25	8	304 53	26 45	24	349 59	72 14	9	35 18	117 48
25	260 53	342 24	9	305 51	27 44	25	350 58	73 14	10	36 18	118 47
26	261 52	343 23	10	306 50	28 43	26	351 56	74 13	11	37 17	119 46
27	262 50	344 22	11	307 49	29 42	27	352 55	75 13	12	38 16	120 46
28	263 49	345 21	12	308 48	30 42	28	353 54	76 12	13	39 15	121 45
29	264 48	346 20	13	309 47	31 41	29	354 53	77 12	14	40 15	122 44
30	265 46	347 19	14	310 45	32 40	30	355 52	78 11	15	41 14	123 44
31	266 45	348 18	15	311 44	33 40	31	356 51	79 10	16	42 14	124 43
Aug. 1	267 44	349 17	16	312 43	34 39	Nov. 1	357 50	80 10	17	43 13	125 42
2	268 42	350 16	17	313 42	35 38	2	358 49	81 09	18	44 12	126 42
3	269 41	351 15	18	314 40	36 38	3	359 48	82 09	19	45 12	127 41
4	270 40	352 14	19	315 39	37 37	4	0 47	83 08	20	46 11	128 40
5	271 38	353 13	20	316 38	38 36	5	1 46	84 07	21	47 11	129 40
6	272 37	354 12	21	317 36	39 35	6	2 45	85 07	22	48 10	130 39
7	273 36	355 12	22	318 35	40 35	7	3 45	86 06	23	49 09	131 38
8	274 34	356 11	23	319 34	41 34	8	4 44	87 06	24	50 09	132 38
9	275 33	357 10	24	320 33	42 33	9	5 43	88 05	25	51 08	133 37
10	276 31	358 09	25	321 32	43 33	10	6 42	89 05	26	52 07	134 36
11	277 30	359 08	26	322 30	44 32	11	7 41	90 04	27	53 07	135 36
12	278 29	0 07	27	323 29	45 31	12	8 40	91 04	28	54 06	136 35
13	279 27	1 06	28	324 28	46 31	13	9 39	92 03	29	55 06	137 34
14	280 26	2 05	29	325 27	47 30	14	10 38	93 02	30	56 05	138 33
15	281 25	3 04	30	326 25	48 29	15	11 37	94 02	31	57 05	139 33
16	282 23	4 03	Oct. 1	327 24	49 29	16	12 36	95 01	32	58 04	140 32

Form the quantities $C = p \cos(\text{local hour angle})$ and $S = p \sin(\text{local hour angle})$ then
 Latitude $= h_0 - C + 0.0087 S^2 \tan h_0$,

Azimuth of *Polaris* $= -S/\cos h_0$ and Azimuth of σ Octantis $= 180^\circ + S/\cos h_0$, where p and h_0 are in degrees and h_0 is the observed altitude corrected for atmospheric refraction and instrument error.



The times of sunrise and sunset (pages 24–31) and of moonrise and moonset (pages 32–63) are the instants when the upper limbs of the Sun and Moon appear to lie on the horizon for an observer at sea-level. In both cases a fixed allowance of 34' has been made for refraction; a further allowance of 16' has been made for the semidiameter of the Sun, while for the Moon the actual value of semidiameter *minus* horizontal parallax has been used. No allowance has been made for the phase of the Moon. The observed times may differ from the tabular times because of variations in refraction and the relative heights of the observer and horizon.

The tabular values are for the universal time (UT) of the phenomena on the Greenwich meridian (longitude 0°). To a first approximation the UT at another longitude is given by subtracting the longitude, expressed in time-measure, if east of Greenwich, or by adding, if west of Greenwich. Alternatively the tables may be regarded as giving the approximate local mean time on all meridians. These times may be converted to standard time by applying the appropriate differences, as indicated in the note on page 4. Linear interpolation may be used to obtain the times for non-tabular latitudes.

In the case of the Sun it may be necessary to interpolate (mentally) to obtain the UT for an intermediate date, but a further interpolation for longitude is not normally required. In the case of the Moon the values must normally be interpolated for longitude, as well as for latitude, since the changes in the tabular values from one day to the next are usually large. The interpolating factor is equal to one twenty-fourth of the longitude if expressed in hours and decimals of an hour; linear interpolation is usually adequate.

Example

To find the times of sunrise and sunset and of moonrise and moonset on 2011 February 18 at latitude N 38° 55', longitude W 77° 15'. The longitude expressed in time-measure is W 05^h 09^m. The difference between standard time and UT is –5^h in this case.

The relevant tabular values in UT for longitude 0° are as follows:

		Sunrise		Sunset				Moonrise		Moonset	
		+35°	+40°	+35°	+40°			+35°	+40°	+35°	+40°
d	h m	h m	h m	h m	h m	d	h m	h m	h m	h m	h m
Feb. 15	06 46	06 53	17 42	17 35		Feb. 18	18 15	18 12	06 25	06 30	
19	06 42	06 48	17 46	17 40		19	19 27	19 28	07 01	07 02	

Interpolating factor for latitude is 3° 55' / 5° = 0.78

for date for Sun is 3^d/4^d = 0.75

for long. for Moon is 5^h 15/24^h = 0.21

		Sunrise		Sunset			Moonrise		Moonset
		d	h m	h m			d	h m	h m
Interpolation to:									
Latitude N 38° 55'		Feb. 15	06 51	17 37		Feb. 18	18 13	06 29	
N 38° 55'		19	06 47	17 41		19	19 28	07 02	
Local mean time		18	06 48	17 40		18	18 29	06 36	

Adjustment to:									
Universal time		18	11 57	22 49		18	23 38	11 45	
Standard time		18	06 57	17 49		18	18 38	06 45	

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -2	3 22	3 52	4 14	4 32	4 47	5 00	5 22	5 41	5 58	6 16	6 34	6 55	7 07	7 21
2	3 27	3 56	4 18	4 35	4 50	5 03	5 24	5 43	6 00	6 17	6 35	6 56	7 08	7 22
6	3 32	4 00	4 22	4 39	4 53	5 06	5 27	5 45	6 02	6 19	6 36	6 57	7 09	7 22
10	3 38	4 06	4 26	4 43	4 57	5 09	5 30	5 47	6 04	6 20	6 37	6 57	7 08	7 22
14	3 45	4 11	4 31	4 47	5 01	5 12	5 32	5 49	6 05	6 21	6 38	6 57	7 08	7 21
18	3 53	4 17	4 36	4 52	5 05	5 16	5 35	5 51	6 07	6 22	6 38	6 56	7 07	7 19
22	4 01	4 24	4 42	4 56	5 09	5 19	5 38	5 53	6 08	6 22	6 38	6 55	7 05	7 17
26	4 09	4 31	4 47	5 01	5 13	5 23	5 40	5 55	6 09	6 23	6 37	6 54	7 03	7 14
30	4 17	4 37	4 53	5 06	5 17	5 26	5 43	5 57	6 10	6 23	6 36	6 52	7 01	7 11
Feb. 3	4 26	4 45	4 59	5 11	5 21	5 30	5 45	5 58	6 10	6 22	6 35	6 49	6 58	7 07
7	4 35	4 52	5 05	5 16	5 25	5 33	5 47	5 59	6 11	6 22	6 33	6 47	6 54	7 03
11	4 43	4 59	5 11	5 21	5 29	5 37	5 50	6 01	6 11	6 21	6 32	6 44	6 51	6 58
15	4 52	5 06	5 17	5 26	5 33	5 40	5 52	6 01	6 11	6 20	6 29	6 40	6 46	6 53
19	5 01	5 13	5 22	5 30	5 37	5 43	5 53	6 02	6 10	6 19	6 27	6 37	6 42	6 48
23	5 09	5 20	5 28	5 35	5 41	5 46	5 55	6 03	6 10	6 17	6 24	6 33	6 37	6 43
27	5 18	5 27	5 34	5 40	5 45	5 49	5 57	6 03	6 09	6 15	6 22	6 29	6 33	6 37
Mar. 3	5 26	5 33	5 39	5 44	5 48	5 52	5 58	6 04	6 09	6 14	6 19	6 24	6 27	6 31
7	5 34	5 40	5 45	5 49	5 52	5 55	6 00	6 04	6 08	6 12	6 15	6 20	6 22	6 25
11	5 42	5 47	5 50	5 53	5 55	5 57	6 01	6 04	6 07	6 09	6 12	6 15	6 17	6 19
15	5 50	5 53	5 55	5 57	5 59	6 00	6 02	6 04	6 06	6 07	6 09	6 10	6 11	6 12
19	5 58	6 00	6 01	6 01	6 02	6 03	6 03	6 04	6 05	6 05	6 05	6 06	6 06	6 06
23	6 06	6 06	6 06	6 05	6 05	6 05	6 05	6 04	6 03	6 03	6 02	6 01	6 00	5 59
27	6 14	6 12	6 11	6 09	6 08	6 07	6 06	6 04	6 02	6 00	5 58	5 56	5 55	5 53
31	6 22	6 18	6 16	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 55	5 51	5 49	5 46
Apr. 4	6 29	6 25	6 21	6 18	6 15	6 12	6 08	6 04	6 00	5 56	5 51	5 46	5 43	5 40

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -2	20 41	20 12	19 49	19 32	19 17	19 04	18 42	18 23	18 06	17 48	17 30	17 09	16 57	16 43
2	20 40	20 11	19 50	19 32	19 17	19 05	18 43	18 25	18 08	17 51	17 33	17 12	17 00	16 46
6	20 38	20 10	19 49	19 32	19 18	19 05	18 44	18 26	18 09	17 53	17 35	17 15	17 03	16 50
10	20 36	20 09	19 48	19 31	19 18	19 06	18 45	18 27	18 11	17 55	17 38	17 18	17 07	16 53
14	20 32	20 06	19 46	19 30	19 17	19 05	18 45	18 28	18 13	17 57	17 40	17 21	17 10	16 58
18	20 27	20 02	19 44	19 28	19 16	19 04	18 46	18 29	18 14	17 59	17 43	17 25	17 14	17 02
22	20 21	19 58	19 40	19 26	19 14	19 03	18 45	18 30	18 15	18 01	17 46	17 28	17 18	17 07
26	20 15	19 53	19 37	19 23	19 12	19 02	18 45	18 30	18 16	18 02	17 48	17 32	17 22	17 11
30	20 08	19 48	19 32	19 20	19 09	19 00	18 44	18 30	18 17	18 04	17 50	17 35	17 26	17 16
Feb. 3	20 00	19 42	19 28	19 16	19 06	18 57	18 42	18 29	18 17	18 05	17 53	17 39	17 30	17 21
7	19 52	19 36	19 22	19 12	19 02	18 54	18 41	18 29	18 18	18 07	17 55	17 42	17 34	17 26
11	19 44	19 29	19 17	19 07	18 59	18 51	18 39	18 28	18 18	18 08	17 57	17 45	17 38	17 31
15	19 35	19 21	19 11	19 02	18 54	18 48	18 36	18 27	18 18	18 09	17 59	17 48	17 42	17 35
19	19 26	19 14	19 04	18 57	18 50	18 44	18 34	18 25	18 17	18 09	18 01	17 51	17 46	17 40
23	19 16	19 06	18 58	18 51	18 45	18 40	18 31	18 24	18 17	18 10	18 03	17 54	17 50	17 45
27	19 07	18 58	18 51	18 45	18 40	18 36	18 28	18 22	18 16	18 10	18 04	17 57	17 53	17 49
Mar. 3	18 57	18 50	18 44	18 39	18 35	18 31	18 25	18 20	18 15	18 11	18 06	18 00	17 57	17 54
7	18 47	18 41	18 37	18 33	18 30	18 27	18 22	18 18	18 14	18 11	18 07	18 03	18 01	17 58
11	18 37	18 33	18 29	18 27	18 24	18 22	18 19	18 16	18 13	18 11	18 08	18 05	18 04	18 02
15	18 27	18 24	18 22	18 20	18 19	18 18	18 15	18 14	18 12	18 11	18 09	18 08	18 07	18 06
19	18 16	18 15	18 14	18 14	18 13	18 13	18 12	18 12	18 11	18 11	18 11	18 11	18 11	18 11
23	18 06	18 07	18 07	18 07	18 08	18 08	18 09	18 09	18 10	18 11	18 12	18 13	18 14	18 15
27	17 56	17 58	17 59	18 01	18 02	18 03	18 05	18 07	18 09	18 11	18 13	18 15	18 17	18 19
31	17 46	17 49	17 52	17 54	17 56	17 58	18 02	18 05	18 08	18 11	18 14	18 18	18 20	18 23
Apr. 4	17 36	17 41	17 45	17 48	17 51	17 54	17 58	18 02	18 06	18 10	18 15	18 20	18 23	18 27

SUNRISE AND SUNSET, 2011

25

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -2	7 21	7 28	7 34	7 42	7 50	7 58	8 08	8 19	8 32	8 46	9 03	9 25	9 52	10 32
2	7 22	7 28	7 35	7 42	7 50	7 58	8 08	8 19	8 31	8 45	9 02	9 22	9 49	10 27
6	7 22	7 28	7 35	7 42	7 49	7 58	8 07	8 17	8 29	8 43	8 59	9 19	9 44	10 18
10	7 22	7 27	7 34	7 41	7 48	7 56	8 05	8 15	8 26	8 40	8 55	9 13	9 37	10 08
14	7 21	7 26	7 32	7 39	7 46	7 54	8 02	8 12	8 23	8 35	8 50	9 07	9 29	9 57
18	7 19	7 24	7 30	7 36	7 43	7 50	7 59	8 08	8 18	8 30	8 43	8 59	9 19	9 45
22	7 17	7 22	7 27	7 33	7 40	7 47	7 54	8 03	8 12	8 23	8 36	8 51	9 09	9 32
26	7 14	7 19	7 24	7 29	7 35	7 42	7 49	7 57	8 06	8 16	8 28	8 42	8 58	9 18
30	7 11	7 15	7 20	7 25	7 31	7 37	7 44	7 51	7 59	8 09	8 19	8 32	8 46	9 04
Feb. 3	7 07	7 11	7 16	7 20	7 26	7 31	7 37	7 44	7 52	8 00	8 10	8 21	8 34	8 50
7	7 03	7 07	7 11	7 15	7 20	7 25	7 31	7 37	7 44	7 51	8 00	8 10	8 22	8 36
11	6 58	7 02	7 06	7 09	7 14	7 18	7 23	7 29	7 35	7 42	7 50	7 59	8 09	8 21
15	6 53	6 57	7 00	7 03	7 07	7 11	7 16	7 21	7 26	7 32	7 39	7 47	7 56	8 07
19	6 48	6 51	6 54	6 57	7 00	7 04	7 08	7 12	7 17	7 22	7 28	7 35	7 43	7 52
23	6 43	6 45	6 48	6 50	6 53	6 56	7 00	7 03	7 07	7 12	7 17	7 23	7 29	7 37
27	6 37	6 39	6 41	6 43	6 46	6 48	6 51	6 54	6 58	7 01	7 05	7 10	7 16	7 22
Mar. 3	6 31	6 33	6 34	6 36	6 38	6 40	6 42	6 45	6 47	6 50	6 54	6 58	7 02	7 07
7	6 25	6 26	6 27	6 29	6 30	6 32	6 33	6 35	6 37	6 40	6 42	6 45	6 48	6 52
11	6 19	6 19	6 20	6 21	6 22	6 23	6 24	6 26	6 27	6 28	6 30	6 32	6 34	6 36
15	6 12	6 13	6 13	6 14	6 14	6 15	6 15	6 16	6 17	6 17	6 18	6 19	6 20	6 21
19	6 06	6 06	6 06	6 06	6 06	6 06	6 06	6 06	6 06	6 06	6 06	6 06	6 06	6 06
23	5 59	5 59	5 59	5 58	5 58	5 57	5 57	5 56	5 55	5 55	5 54	5 53	5 52	5 50
27	5 53	5 52	5 51	5 50	5 50	5 49	5 47	5 46	5 45	5 43	5 42	5 40	5 38	5 35
31	5 46	5 45	5 44	5 43	5 41	5 40	5 38	5 36	5 34	5 32	5 30	5 27	5 23	5 20
Apr. 4	5 40	5 38	5 37	5 35	5 33	5 31	5 29	5 27	5 24	5 21	5 18	5 14	5 09	5 04

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -2	16 43	16 37	16 30	16 22	16 14	16 06	15 56	15 45	15 32	15 18	15 01	14 40	14 12	13 32
2	16 46	16 40	16 33	16 26	16 18	16 10	16 00	15 49	15 37	15 23	15 06	14 46	14 19	13 42
6	16 50	16 44	16 37	16 30	16 22	16 14	16 05	15 54	15 42	15 29	15 13	14 53	14 28	13 54
10	16 53	16 48	16 41	16 35	16 27	16 19	16 10	16 00	15 49	15 36	15 20	15 02	14 39	14 07
14	16 58	16 52	16 46	16 39	16 32	16 25	16 16	16 06	15 56	15 43	15 29	15 11	14 50	14 22
18	17 02	16 57	16 51	16 45	16 38	16 31	16 22	16 13	16 03	15 51	15 38	15 22	15 02	14 37
22	17 07	17 02	16 56	16 50	16 44	16 37	16 29	16 21	16 11	16 00	15 48	15 33	15 15	14 52
26	17 11	17 07	17 01	16 56	16 50	16 43	16 36	16 28	16 19	16 09	15 58	15 44	15 28	15 08
30	17 16	17 12	17 07	17 02	16 56	16 50	16 43	16 36	16 28	16 19	16 08	15 56	15 41	15 23
Feb. 3	17 21	17 17	17 12	17 08	17 03	16 57	16 51	16 44	16 37	16 28	16 18	16 07	15 54	15 38
7	17 26	17 22	17 18	17 14	17 09	17 04	16 58	16 52	16 45	16 38	16 29	16 19	16 07	15 53
11	17 31	17 27	17 24	17 20	17 15	17 11	17 06	17 00	16 54	16 47	16 40	16 31	16 20	16 08
15	17 35	17 32	17 29	17 26	17 22	17 18	17 13	17 08	17 03	16 57	16 50	16 42	16 33	16 23
19	17 40	17 37	17 34	17 31	17 28	17 25	17 21	17 16	17 12	17 06	17 01	16 54	16 46	16 37
23	17 45	17 42	17 40	17 37	17 34	17 31	17 28	17 24	17 20	17 16	17 11	17 05	16 59	16 51
27	17 49	17 47	17 45	17 43	17 41	17 38	17 35	17 32	17 29	17 25	17 21	17 17	17 11	17 05
Mar. 3	17 54	17 52	17 50	17 49	17 47	17 45	17 43	17 40	17 38	17 35	17 31	17 28	17 24	17 19
7	17 58	17 57	17 56	17 54	17 53	17 51	17 50	17 48	17 46	17 44	17 41	17 39	17 36	17 32
11	18 02	18 01	18 01	18 00	17 59	17 58	17 57	17 56	17 54	17 53	17 51	17 50	17 48	17 45
15	18 06	18 06	18 06	18 05	18 05	18 04	18 04	18 03	18 03	18 02	18 01	18 01	18 00	17 59
19	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 12
23	18 15	18 15	18 15	18 16	18 16	18 17	18 18	18 18	18 19	18 20	18 21	18 22	18 23	18 25
27	18 19	18 20	18 20	18 21	18 22	18 23	18 25	18 26	18 27	18 29	18 31	18 33	18 35	18 38
31	18 23	18 24	18 25	18 27	18 28	18 30	18 31	18 33	18 35	18 38	18 40	18 43	18 47	18 51
Apr. 4	18 27	18 28	18 30	18 32	18 34	18 36	18 38	18 41	18 44	18 47	18 50	18 54	18 59	19 04

SUNRISE AND SUNSET, 2011

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	6 22	6 18	6 16	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 55	5 51	5 49	5 46
Apr. 4	6 29	6 25	6 21	6 18	6 15	6 12	6 08	6 04	6 00	5 56	5 51	5 46	5 43	5 40
8	6 37	6 31	6 26	6 22	6 18	6 15	6 09	6 04	5 59	5 54	5 48	5 42	5 38	5 34
12	6 45	6 37	6 31	6 26	6 22	6 17	6 10	6 04	5 58	5 51	5 45	5 37	5 33	5 27
16	6 52	6 43	6 36	6 30	6 24	6 19	6 11	6 04	5 57	5 49	5 42	5 33	5 27	5 21
20	7 00	6 49	6 41	6 34	6 27	6 22	6 12	6 04	5 56	5 47	5 39	5 28	5 22	5 16
24	7 08	6 55	6 46	6 38	6 31	6 24	6 14	6 04	5 55	5 46	5 36	5 24	5 18	5 10
28	7 15	7 01	6 51	6 42	6 34	6 27	6 15	6 04	5 54	5 44	5 33	5 20	5 13	5 05
May 2	7 23	7 07	6 55	6 45	6 37	6 29	6 16	6 05	5 54	5 42	5 31	5 17	5 09	4 59
6	7 30	7 13	7 00	6 49	6 40	6 32	6 18	6 05	5 53	5 41	5 28	5 13	5 05	4 55
10	7 37	7 19	7 05	6 53	6 43	6 34	6 19	6 06	5 53	5 40	5 26	5 10	5 01	4 50
14	7 44	7 25	7 10	6 57	6 46	6 37	6 21	6 06	5 53	5 39	5 25	5 08	4 58	4 46
18	7 51	7 30	7 14	7 01	6 49	6 39	6 22	6 07	5 53	5 39	5 23	5 05	4 55	4 43
22	7 57	7 35	7 18	7 04	6 52	6 42	6 24	6 08	5 53	5 38	5 22	5 03	4 52	4 39
26	8 03	7 40	7 22	7 08	6 55	6 44	6 25	6 09	5 53	5 38	5 21	5 01	4 50	4 37
30	8 09	7 45	7 26	7 11	6 58	6 46	6 27	6 10	5 54	5 38	5 20	5 00	4 48	4 34
June 3	8 14	7 49	7 29	7 14	7 00	6 49	6 28	6 11	5 54	5 38	5 20	4 59	4 47	4 33
7	8 18	7 52	7 32	7 16	7 02	6 50	6 30	6 12	5 55	5 38	5 20	4 59	4 46	4 31
11	8 22	7 55	7 35	7 18	7 04	6 52	6 31	6 13	5 56	5 39	5 20	4 58	4 46	4 31
15	8 24	7 57	7 37	7 20	7 06	6 54	6 33	6 14	5 57	5 39	5 20	4 58	4 46	4 31
19	8 26	7 59	7 38	7 21	7 07	6 55	6 34	6 15	5 58	5 40	5 21	4 59	4 46	4 31
23	8 27	8 00	7 39	7 22	7 08	6 56	6 34	6 16	5 58	5 41	5 22	5 00	4 47	4 32
27	8 27	8 00	7 40	7 23	7 09	6 56	6 35	6 17	5 59	5 42	5 23	5 01	4 48	4 33
July 1	8 26	8 00	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 02	4 49	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 25	5 04	4 51	4 37

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	17 46	17 49	17 52	17 54	17 56	17 58	18 02	18 05	18 08	18 11	18 14	18 18	18 20	18 23
Apr. 4	17 36	17 41	17 45	17 48	17 51	17 54	17 58	18 02	18 06	18 10	18 15	18 20	18 23	18 27
8	17 26	17 32	17 37	17 42	17 46	17 49	17 55	18 00	18 05	18 10	18 16	18 23	18 27	18 31
12	17 16	17 24	17 30	17 36	17 40	17 44	17 52	17 58	18 04	18 10	18 17	18 25	18 30	18 35
16	17 07	17 16	17 23	17 30	17 35	17 40	17 48	17 56	18 03	18 11	18 18	18 28	18 33	18 39
20	16 57	17 08	17 17	17 24	17 30	17 36	17 45	17 54	18 02	18 11	18 20	18 30	18 36	18 43
24	16 48	17 00	17 10	17 18	17 25	17 32	17 43	17 52	18 02	18 11	18 21	18 33	18 39	18 47
28	16 39	16 53	17 04	17 13	17 21	17 28	17 40	17 51	18 01	18 11	18 22	18 35	18 43	18 51
May 2	16 31	16 46	16 58	17 08	17 17	17 24	17 38	17 49	18 00	18 12	18 24	18 38	18 46	18 55
6	16 23	16 39	16 53	17 03	17 13	17 21	17 35	17 48	18 00	18 12	18 25	18 40	18 49	18 59
10	16 15	16 33	16 47	16 59	17 09	17 18	17 34	17 47	18 00	18 13	18 27	18 43	18 52	19 03
14	16 08	16 27	16 43	16 55	17 06	17 15	17 32	17 46	18 00	18 14	18 28	18 46	18 56	19 07
18	16 01	16 22	16 38	16 52	17 03	17 13	17 30	17 46	18 00	18 14	18 30	18 48	18 59	19 11
22	15 56	16 18	16 35	16 49	17 01	17 11	17 29	17 45	18 00	18 15	18 32	18 51	19 02	19 14
26	15 50	16 13	16 31	16 46	16 59	17 10	17 28	17 45	18 01	18 16	18 33	18 53	19 05	19 18
30	15 46	16 10	16 29	16 44	16 57	17 08	17 28	17 45	18 01	18 17	18 35	18 55	19 07	19 21
June 3	15 42	16 07	16 27	16 43	16 56	17 08	17 28	17 45	18 02	18 18	18 36	18 57	19 10	19 24
7	15 39	16 05	16 25	16 41	16 55	17 07	17 28	17 46	18 02	18 20	18 38	18 59	19 12	19 26
11	15 37	16 04	16 24	16 41	16 55	17 07	17 28	17 46	18 03	18 21	18 39	19 01	19 14	19 29
15	15 36	16 03	16 24	16 41	16 55	17 07	17 28	17 47	18 04	18 22	18 41	19 02	19 15	19 30
19	15 36	16 04	16 24	16 41	16 55	17 08	17 29	17 48	18 05	18 23	18 42	19 04	19 17	19 32
23	15 37	16 04	16 25	16 42	16 56	17 09	17 30	17 48	18 06	18 23	18 42	19 04	19 18	19 33
27	15 39	16 06	16 27	16 43	16 57	17 10	17 31	17 49	18 07	18 24	18 43	19 05	19 18	19 33
July 1	15 42	16 08	16 29	16 45	16 59	17 11	17 32	17 50	18 07	18 25	18 43	19 05	19 18	19 33
5	15 45	16 11	16 31	16 47	17 01	17 13	17 33	17 51	18 08	18 25	18 44	19 05	19 18	19 32

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	5 46	5 45	5 44	5 43	5 41	5 40	5 38	5 36	5 34	5 32	5 30	5 27	5 23	5 20
Apr. 4	5 40	5 38	5 37	5 35	5 33	5 31	5 29	5 27	5 24	5 21	5 18	5 14	5 09	5 04
8	5 34	5 32	5 30	5 28	5 25	5 23	5 20	5 17	5 13	5 10	5 05	5 01	4 55	4 49
12	5 27	5 25	5 23	5 20	5 17	5 14	5 11	5 07	5 03	4 59	4 54	4 48	4 41	4 33
16	5 21	5 19	5 16	5 13	5 10	5 06	5 02	4 58	4 53	4 48	4 42	4 35	4 27	4 18
20	5 16	5 13	5 09	5 06	5 02	4 58	4 54	4 49	4 43	4 37	4 30	4 22	4 13	4 02
24	5 10	5 07	5 03	4 59	4 55	4 50	4 45	4 40	4 33	4 26	4 19	4 10	3 59	3 46
28	5 05	5 01	4 57	4 52	4 48	4 43	4 37	4 31	4 24	4 16	4 07	3 57	3 45	3 31
May 2	4 59	4 55	4 51	4 46	4 41	4 35	4 29	4 22	4 15	4 06	3 56	3 45	3 31	3 15
6	4 55	4 50	4 45	4 40	4 35	4 29	4 22	4 14	4 06	3 57	3 46	3 33	3 18	2 59
10	4 50	4 45	4 40	4 35	4 29	4 22	4 15	4 07	3 58	3 47	3 35	3 21	3 05	2 44
14	4 46	4 41	4 36	4 30	4 23	4 16	4 08	4 00	3 50	3 39	3 26	3 10	2 52	2 28
18	4 43	4 37	4 31	4 25	4 18	4 11	4 02	3 53	3 43	3 31	3 16	3 00	2 39	2 12
22	4 39	4 34	4 28	4 21	4 14	4 06	3 57	3 47	3 36	3 23	3 08	2 50	2 27	1 56
26	4 37	4 31	4 24	4 17	4 10	4 01	3 52	3 42	3 30	3 16	3 00	2 40	2 15	1 39
30	4 34	4 28	4 22	4 14	4 06	3 58	3 48	3 37	3 25	3 10	2 53	2 32	2 04	1 22
June 3	4 33	4 26	4 19	4 12	4 04	3 55	3 45	3 33	3 20	3 05	2 47	2 24	1 54	1 05
7	4 31	4 25	4 18	4 10	4 02	3 53	3 42	3 30	3 17	3 01	2 42	2 18	1 45	0 47
11	4 31	4 24	4 17	4 09	4 01	3 51	3 40	3 28	3 15	2 58	2 39	2 14	1 38	0 24
15	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 57	2 36	2 10	1 34	□
19	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 56	2 36	2 09	1 31	□
23	4 32	4 25	4 18	4 10	4 01	3 51	3 40	3 28	3 14	2 57	2 36	2 10	1 32	□
27	4 33	4 26	4 19	4 11	4 02	3 53	3 42	3 29	3 15	2 59	2 38	2 12	1 35	□
July 1	4 35	4 28	4 21	4 13	4 04	3 55	3 44	3 32	3 18	3 02	2 42	2 16	1 40	0 15
5	4 37	4 30	4 23	4 15	4 07	3 58	3 47	3 35	3 22	3 06	2 46	2 22	1 48	0 45

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	18 23	18 24	18 25	18 27	18 28	18 30	18 31	18 33	18 35	18 38	18 40	18 43	18 47	18 51
Apr. 4	18 27	18 28	18 30	18 32	18 34	18 36	18 38	18 41	18 44	18 47	18 50	18 54	18 59	19 04
8	18 31	18 33	18 35	18 37	18 40	18 42	18 45	18 48	18 52	18 56	19 00	19 05	19 11	19 17
12	18 35	18 37	18 40	18 42	18 45	18 49	18 52	18 56	19 00	19 05	19 10	19 16	19 23	19 31
16	18 39	18 42	18 45	18 48	18 51	18 55	18 59	19 03	19 08	19 14	19 20	19 27	19 35	19 44
20	18 43	18 46	18 49	18 53	18 57	19 01	19 06	19 11	19 16	19 22	19 30	19 38	19 47	19 58
24	18 47	18 51	18 54	18 58	19 03	19 07	19 12	19 18	19 24	19 31	19 40	19 49	20 00	20 13
28	18 51	18 55	18 59	19 04	19 08	19 13	19 19	19 25	19 33	19 40	19 49	20 00	20 12	20 27
May 2	18 55	18 59	19 04	19 09	19 14	19 20	19 26	19 33	19 41	19 49	19 59	20 11	20 25	20 42
6	18 59	19 04	19 09	19 14	19 20	19 26	19 33	19 40	19 49	19 58	20 09	20 22	20 38	20 57
10	19 03	19 08	19 13	19 19	19 25	19 32	19 39	19 47	19 56	20 07	20 19	20 33	20 51	21 12
14	19 07	19 12	19 18	19 24	19 30	19 37	19 45	19 54	20 04	20 15	20 29	20 44	21 04	21 28
18	19 11	19 16	19 22	19 29	19 35	19 43	19 51	20 01	20 12	20 24	20 38	20 55	21 16	21 45
22	19 14	19 20	19 26	19 33	19 40	19 48	19 57	20 07	20 19	20 32	20 47	21 06	21 29	22 01
26	19 18	19 24	19 30	19 37	19 45	19 53	20 03	20 13	20 25	20 39	20 55	21 16	21 42	22 19
30	19 21	19 27	19 34	19 41	19 49	19 58	20 08	20 19	20 31	20 46	21 03	21 25	21 53	22 36
June 3	19 24	19 30	19 37	19 45	19 53	20 02	20 12	20 24	20 37	20 52	21 10	21 33	22 04	22 55
7	19 26	19 33	19 40	19 48	19 56	20 06	20 16	20 28	20 41	20 57	21 16	21 41	22 14	23 16
11	19 29	19 35	19 43	19 50	19 59	20 08	20 19	20 31	20 45	21 01	21 21	21 47	22 22	23 43
15	19 30	19 37	19 44	19 52	20 01	20 11	20 22	20 34	20 48	21 05	21 25	21 51	22 28	□
19	19 32	19 39	19 46	19 54	20 03	20 12	20 23	20 36	20 50	21 07	21 27	21 54	22 32	□
23	19 33	19 39	19 47	19 55	20 03	20 13	20 24	20 36	20 51	21 07	21 28	21 54	22 32	□
27	19 33	19 40	19 47	19 55	20 04	20 13	20 24	20 36	20 50	21 07	21 27	21 53	22 30	□
July 1	19 33	19 39	19 47	19 55	20 03	20 13	20 23	20 35	20 49	21 05	21 25	21 50	22 26	23 43
5	19 32	19 39	19 46	19 53	20 02	20 11	20 22	20 33	20 47	21 03	21 22	21 46	22 19	23 19

□ indicates Sun continuously above horizon.

SUNRISE AND SUNSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	8 26	8 00	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 02	4 49	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 25	5 04	4 51	4 37
9	8 22	7 56	7 37	7 21	7 08	6 56	6 36	6 18	6 02	5 45	5 27	5 06	4 53	4 39
13	8 18	7 54	7 35	7 19	7 06	6 55	6 35	6 18	6 02	5 46	5 28	5 08	4 56	4 42
17	8 14	7 50	7 32	7 17	7 05	6 54	6 35	6 18	6 03	5 47	5 30	5 10	4 58	4 45
21	8 08	7 46	7 29	7 15	7 03	6 52	6 34	6 18	6 03	5 48	5 31	5 12	5 01	4 48
25	8 02	7 42	7 25	7 12	7 00	6 50	6 33	6 17	6 03	5 48	5 33	5 15	5 04	4 52
29	7 56	7 36	7 21	7 08	6 57	6 48	6 31	6 17	6 03	5 49	5 34	5 17	5 07	4 55
Aug. 2	7 49	7 31	7 16	7 04	6 54	6 45	6 29	6 16	6 03	5 50	5 36	5 19	5 10	4 59
6	7 41	7 24	7 11	7 00	6 50	6 42	6 27	6 15	6 02	5 50	5 37	5 22	5 13	5 03
10	7 33	7 18	7 05	6 55	6 46	6 39	6 25	6 13	6 02	5 51	5 38	5 24	5 16	5 06
14	7 25	7 11	6 59	6 50	6 42	6 35	6 23	6 12	6 01	5 51	5 40	5 27	5 19	5 10
18	7 16	7 03	6 53	6 45	6 38	6 31	6 20	6 10	6 01	5 51	5 41	5 29	5 22	5 14
22	7 07	6 56	6 47	6 39	6 33	6 27	6 17	6 08	6 00	5 51	5 42	5 31	5 25	5 18
26	6 57	6 48	6 40	6 33	6 28	6 23	6 14	6 06	5 59	5 51	5 43	5 33	5 28	5 22
30	6 48	6 39	6 33	6 27	6 22	6 18	6 11	6 04	5 57	5 51	5 44	5 36	5 31	5 25
Sept. 3	6 38	6 31	6 26	6 21	6 17	6 13	6 07	6 02	5 56	5 51	5 45	5 38	5 34	5 29
7	6 28	6 23	6 18	6 15	6 12	6 09	6 04	5 59	5 55	5 50	5 46	5 40	5 37	5 33
11	6 18	6 14	6 11	6 08	6 06	6 04	6 00	5 57	5 53	5 50	5 46	5 42	5 40	5 37
15	6 08	6 05	6 03	6 02	6 00	5 59	5 56	5 54	5 52	5 50	5 47	5 44	5 42	5 40
19	5 57	5 56	5 56	5 55	5 54	5 54	5 53	5 52	5 51	5 49	5 48	5 46	5 45	5 44
23	5 47	5 48	5 48	5 48	5 49	5 49	5 49	5 49	5 49	5 49	5 49	5 49	5 48	5 48
27	5 37	5 39	5 40	5 42	5 43	5 44	5 45	5 47	5 48	5 49	5 50	5 51	5 51	5 52
Oct. 1	5 27	5 30	5 33	5 35	5 37	5 39	5 42	5 44	5 47	5 49	5 51	5 53	5 54	5 56
5	5 16	5 21	5 25	5 29	5 32	5 34	5 38	5 42	5 45	5 48	5 52	5 55	5 57	6 00

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	15 42	16 08	16 29	16 45	16 59	17 11	17 32	17 50	18 07	18 25	18 43	19 05	19 18	19 33
5	15 45	16 11	16 31	16 47	17 01	17 13	17 33	17 51	18 08	18 25	18 44	19 05	19 18	19 32
9	15 49	16 14	16 34	16 50	17 03	17 15	17 35	17 52	18 09	18 26	18 44	19 04	19 17	19 31
13	15 54	16 18	16 37	16 52	17 05	17 17	17 36	17 53	18 09	18 26	18 43	19 03	19 15	19 29
17	15 59	16 22	16 40	16 55	17 08	17 19	17 38	17 54	18 10	18 25	18 42	19 02	19 14	19 27
21	16 05	16 27	16 44	16 58	17 10	17 21	17 39	17 55	18 10	18 25	18 41	19 00	19 11	19 24
25	16 11	16 32	16 48	17 02	17 13	17 23	17 41	17 56	18 10	18 25	18 40	18 58	19 09	19 21
29	16 18	16 37	16 53	17 05	17 16	17 26	17 42	17 56	18 10	18 24	18 39	18 56	19 06	19 17
Aug. 2	16 24	16 43	16 57	17 09	17 19	17 28	17 43	17 57	18 10	18 23	18 37	18 53	19 02	19 13
6	16 31	16 48	17 01	17 12	17 22	17 30	17 45	17 57	18 09	18 22	18 35	18 50	18 59	19 09
10	16 38	16 54	17 06	17 16	17 25	17 33	17 46	17 58	18 09	18 20	18 32	18 46	18 54	19 04
14	16 46	16 59	17 11	17 20	17 28	17 35	17 47	17 58	18 08	18 18	18 30	18 43	18 50	18 59
18	16 53	17 05	17 15	17 24	17 31	17 37	17 48	17 58	18 07	18 17	18 27	18 39	18 45	18 53
22	17 00	17 11	17 20	17 27	17 34	17 39	17 49	17 58	18 06	18 15	18 24	18 34	18 40	18 47
26	17 07	17 17	17 25	17 31	17 37	17 42	17 50	17 58	18 05	18 13	18 21	18 30	18 35	18 42
30	17 15	17 23	17 29	17 35	17 40	17 44	17 51	17 58	18 04	18 10	18 17	18 25	18 30	18 35
Sept. 3	17 22	17 29	17 34	17 38	17 42	17 46	17 52	17 57	18 03	18 08	18 14	18 21	18 25	18 29
7	17 29	17 35	17 39	17 42	17 45	17 48	17 53	17 57	18 01	18 06	18 10	18 16	18 19	18 23
11	17 37	17 40	17 43	17 46	17 48	17 50	17 54	17 57	18 00	18 03	18 07	18 11	18 13	18 16
15	17 44	17 46	17 48	17 50	17 51	17 52	17 54	17 57	17 59	18 01	18 03	18 06	18 08	18 10
19	17 52	17 52	17 53	17 53	17 54	17 54	17 55	17 56	17 57	17 58	17 59	18 01	18 02	18 03
23	17 59	17 58	17 58	17 57	17 57	17 57	17 56	17 56	17 56	17 56	17 56	17 56	17 56	17 56
27	18 07	18 04	18 03	18 01	18 00	17 59	17 57	17 56	17 54	17 53	17 52	17 51	17 50	17 50
Oct. 1	18 14	18 10	18 07	18 05	18 03	18 01	17 58	17 55	17 53	17 51	17 48	17 46	17 45	17 43
5	18 22	18 17	18 12	18 09	18 06	18 03	17 59	17 55	17 52	17 48	17 45	17 41	17 39	17 37

SUNRISE AND SUNSET, 2011

29

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	4 35	4 28	4 21	4 13	4 04	3 55	3 44	3 32	3 18	3 02	2 42	2 16	1 40	0 15
5	4 37	4 30	4 23	4 15	4 07	3 58	3 47	3 35	3 22	3 06	2 46	2 22	1 48	0 45
9	4 39	4 33	4 26	4 18	4 10	4 01	3 51	3 39	3 26	3 11	2 52	2 29	1 58	1 06
13	4 42	4 36	4 29	4 22	4 14	4 05	3 55	3 44	3 31	3 17	2 59	2 37	2 09	1 25
17	4 45	4 39	4 32	4 25	4 18	4 09	4 00	3 49	3 37	3 23	3 07	2 46	2 20	1 42
21	4 48	4 42	4 36	4 29	4 22	4 14	4 05	3 55	3 44	3 30	3 15	2 56	2 32	2 00
25	4 52	4 46	4 40	4 34	4 27	4 19	4 11	4 01	3 50	3 38	3 24	3 06	2 45	2 16
29	4 55	4 50	4 44	4 38	4 32	4 25	4 17	4 08	3 58	3 46	3 33	3 17	2 57	2 32
Aug. 2	4 59	4 54	4 49	4 43	4 37	4 30	4 23	4 14	4 05	3 54	3 42	3 28	3 10	2 48
6	5 03	4 58	4 53	4 48	4 42	4 36	4 29	4 21	4 13	4 03	3 52	3 38	3 23	3 03
10	5 06	5 02	4 58	4 53	4 47	4 42	4 35	4 28	4 20	4 11	4 01	3 49	3 35	3 18
14	5 10	5 06	5 02	4 58	4 53	4 47	4 42	4 35	4 28	4 20	4 11	4 00	3 48	3 32
18	5 14	5 10	5 07	5 03	4 58	4 53	4 48	4 42	4 36	4 29	4 20	4 11	4 00	3 46
22	5 18	5 15	5 11	5 08	5 04	4 59	4 55	4 50	4 44	4 37	4 30	4 22	4 12	4 00
26	5 22	5 19	5 16	5 13	5 09	5 05	5 01	4 57	4 52	4 46	4 40	4 32	4 24	4 14
30	5 25	5 23	5 20	5 18	5 15	5 11	5 08	5 04	4 59	4 55	4 49	4 43	4 36	4 27
Sept. 3	5 29	5 27	5 25	5 23	5 20	5 17	5 14	5 11	5 07	5 03	4 59	4 53	4 47	4 40
7	5 33	5 31	5 29	5 28	5 25	5 23	5 21	5 18	5 15	5 12	5 08	5 04	4 59	4 53
11	5 37	5 35	5 34	5 33	5 31	5 29	5 27	5 25	5 23	5 20	5 17	5 14	5 10	5 06
15	5 40	5 40	5 39	5 38	5 36	5 35	5 34	5 32	5 31	5 29	5 27	5 24	5 22	5 19
19	5 44	5 44	5 43	5 43	5 42	5 41	5 40	5 39	5 38	5 37	5 36	5 35	5 33	5 31
23	5 48	5 48	5 48	5 48	5 47	5 47	5 47	5 47	5 46	5 46	5 46	5 45	5 45	5 44
27	5 52	5 52	5 52	5 53	5 53	5 53	5 53	5 54	5 54	5 55	5 55	5 55	5 56	5 57
Oct. 1	5 56	5 56	5 57	5 58	5 58	5 59	6 00	6 01	6 02	6 03	6 04	6 06	6 07	6 09
5	6 00	6 01	6 02	6 03	6 04	6 05	6 07	6 08	6 10	6 12	6 14	6 16	6 19	6 22

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	19 33	19 39	19 47	19 55	20 03	20 13	20 23	20 35	20 49	21 05	21 25	21 50	22 26	23 43
5	19 32	19 39	19 46	19 53	20 02	20 11	20 22	20 33	20 47	21 03	21 22	21 46	22 19	23 19
9	19 31	19 37	19 44	19 52	20 00	20 09	20 19	20 30	20 43	20 59	21 17	21 40	22 10	23 00
13	19 29	19 35	19 42	19 49	19 57	20 06	20 16	20 27	20 39	20 54	21 11	21 33	22 01	22 43
17	19 27	19 33	19 39	19 46	19 54	20 02	20 12	20 22	20 34	20 48	21 04	21 24	21 50	22 26
21	19 24	19 30	19 36	19 43	19 50	19 58	20 07	20 17	20 28	20 41	20 56	21 15	21 38	22 10
25	19 21	19 26	19 32	19 39	19 45	19 53	20 01	20 11	20 21	20 34	20 48	21 05	21 26	21 54
29	19 17	19 22	19 28	19 34	19 40	19 48	19 55	20 04	20 14	20 25	20 39	20 54	21 13	21 38
Aug. 2	19 13	19 18	19 23	19 29	19 35	19 42	19 49	19 57	20 06	20 17	20 29	20 43	21 00	21 22
6	19 09	19 13	19 18	19 23	19 29	19 35	19 42	19 49	19 58	20 08	20 19	20 32	20 47	21 06
10	19 04	19 08	19 12	19 17	19 23	19 28	19 34	19 41	19 49	19 58	20 08	20 20	20 33	20 50
14	18 59	19 02	19 07	19 11	19 16	19 21	19 27	19 33	19 40	19 48	19 57	20 07	20 20	20 34
18	18 53	18 57	19 00	19 04	19 09	19 13	19 19	19 24	19 31	19 38	19 46	19 55	20 06	20 19
22	18 47	18 51	18 54	18 57	19 01	19 06	19 10	19 15	19 21	19 27	19 34	19 42	19 52	20 03
26	18 42	18 44	18 47	18 50	18 54	18 57	19 01	19 06	19 11	19 16	19 23	19 30	19 38	19 48
30	18 35	18 38	18 40	18 43	18 46	18 49	18 53	18 56	19 01	19 05	19 11	19 17	19 24	19 32
Sept. 3	18 29	18 31	18 33	18 35	18 38	18 41	18 44	18 47	18 50	18 54	18 59	19 04	19 10	19 16
7	18 23	18 24	18 26	18 28	18 30	18 32	18 34	18 37	18 40	18 43	18 47	18 51	18 56	19 01
11	18 16	18 17	18 19	18 20	18 22	18 23	18 25	18 27	18 29	18 32	18 35	18 38	18 41	18 46
15	18 10	18 10	18 11	18 12	18 13	18 15	18 16	18 17	18 19	18 20	18 22	18 25	18 27	18 30
19	18 03	18 03	18 04	18 04	18 05	18 06	18 06	18 07	18 08	18 09	18 10	18 11	18 13	18 15
23	17 56	17 56	17 56	17 57	17 57	17 57	17 57	17 57	17 57	17 58	17 58	17 58	17 59	17 59
27	17 50	17 49	17 49	17 49	17 48	17 48	17 48	17 47	17 47	17 46	17 46	17 45	17 45	17 44
Oct. 1	17 43	17 42	17 42	17 41	17 40	17 39	17 38	17 37	17 36	17 35	17 34	17 32	17 31	17 29
5	17 37	17 36	17 35	17 33	17 32	17 31	17 29	17 28	17 26	17 24	17 22	17 19	17 17	17 13

SUNRISE AND SUNSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.		−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct.	1	5 27	5 30	5 33	5 35	5 37	5 39	5 42	5 44	5 47	5 49	5 51	5 53	5 54	5 56
	5	5 16	5 21	5 25	5 29	5 32	5 34	5 38	5 42	5 45	5 48	5 52	5 55	5 57	6 00
	9	5 06	5 13	5 18	5 22	5 26	5 29	5 35	5 40	5 44	5 48	5 53	5 58	6 01	6 04
	13	4 56	5 04	5 11	5 16	5 21	5 25	5 32	5 38	5 43	5 48	5 54	6 00	6 04	6 08
	17	4 46	4 56	5 04	5 10	5 15	5 20	5 28	5 36	5 42	5 49	5 55	6 03	6 07	6 12
	21	4 37	4 48	4 57	5 04	5 11	5 16	5 26	5 34	5 41	5 49	5 57	6 06	6 11	6 16
	25	4 27	4 40	4 50	4 59	5 06	5 12	5 23	5 32	5 41	5 49	5 58	6 08	6 14	6 21
	29	4 18	4 33	4 44	4 53	5 01	5 08	5 20	5 31	5 40	5 50	6 00	6 11	6 18	6 25
	Nov. 2	4 10	4 25	4 38	4 48	4 57	5 05	5 18	5 30	5 40	5 51	6 02	6 14	6 21	6 30
		6	4 01	4 19	4 32	4 44	4 53	5 02	5 16	5 29	5 40	5 52	6 04	6 17	6 25
	10	3 53	4 12	4 27	4 40	4 50	4 59	5 15	5 28	5 40	5 53	6 06	6 21	6 29	6 39
	14	3 46	4 07	4 23	4 36	4 47	4 57	5 13	5 28	5 41	5 54	6 08	6 24	6 33	6 43
	18	3 39	4 01	4 19	4 33	4 44	4 55	5 12	5 27	5 42	5 55	6 10	6 27	6 37	6 48
	22	3 33	3 57	4 15	4 30	4 42	4 53	5 12	5 28	5 42	5 57	6 13	6 30	6 41	6 53
	26	3 28	3 53	4 12	4 28	4 41	4 52	5 11	5 28	5 44	5 59	6 15	6 34	6 45	6 57
	30	3 23	3 50	4 10	4 26	4 40	4 51	5 11	5 29	5 45	6 01	6 18	6 37	6 48	7 01
	Dec. 4	3 20	3 47	4 08	4 25	4 39	4 51	5 12	5 30	5 46	6 03	6 20	6 40	6 52	7 05
		8	3 17	3 46	4 07	4 24	4 39	4 51	5 13	5 31	5 48	6 05	6 23	6 43	6 55
	12	3 16	3 45	4 07	4 25	4 39	4 52	5 14	5 33	5 50	6 07	6 25	6 46	6 58	7 12
	16	3 15	3 45	4 08	4 25	4 40	4 53	5 15	5 34	5 52	6 09	6 27	6 49	7 01	7 15
	20	3 16	3 46	4 09	4 27	4 42	4 55	5 17	5 36	5 54	6 11	6 30	6 51	7 03	7 17
	24	3 18	3 48	4 11	4 29	4 44	4 57	5 19	5 38	5 56	6 13	6 32	6 53	7 05	7 19
	28	3 21	3 51	4 13	4 31	4 46	4 59	5 21	5 40	5 58	6 15	6 33	6 55	7 07	7 21
	32	3 25	3 55	4 17	4 34	4 49	5 02	5 24	5 42	6 00	6 17	6 35	6 56	7 08	7 22
	36	3 30	3 59	4 21	4 38	4 52	5 05	5 26	5 44	6 01	6 18	6 36	6 57	7 08	7 22

SUNSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct.	1	18 14	18 10	18 07	18 05	18 03	18 01	17 58	17 55	17 53	17 51	17 48	17 46	17 45	17 43
	5	18 22	18 17	18 12	18 09	18 06	18 03	17 59	17 55	17 52	17 48	17 45	17 41	17 39	17 37
	9	18 30	18 23	18 18	18 13	18 09	18 06	18 00	17 55	17 51	17 46	17 42	17 36	17 34	17 30
	13	18 38	18 29	18 23	18 17	18 13	18 08	18 01	17 55	17 50	17 44	17 38	17 32	17 28	17 24
	17	18 46	18 36	18 28	18 21	18 16	18 11	18 03	17 55	17 49	17 42	17 35	17 28	17 23	17 18
	21	18 54	18 42	18 33	18 26	18 19	18 14	18 04	17 56	17 48	17 40	17 32	17 23	17 18	17 12
	25	19 02	18 49	18 39	18 30	18 23	18 17	18 06	17 56	17 47	17 39	17 30	17 19	17 14	17 07
	29	19 10	18 56	18 44	18 35	18 27	18 20	18 07	17 57	17 47	17 38	17 27	17 16	17 09	17 02
	Nov. 2	19 19	19 03	18 50	18 39	18 31	18 23	18 09	17 58	17 47	17 36	17 25	17 13	17 05	16 57
		6	19 27	19 10	18 56	18 44	18 34	18 26	18 11	17 59	17 47	17 36	17 23	17 10	16 53
	10	19 36	19 16	19 01	18 49	18 38	18 29	18 14	18 00	17 47	17 35	17 22	17 07	16 58	16 48
	14	19 44	19 23	19 07	18 54	18 42	18 33	18 16	18 01	17 48	17 35	17 21	17 05	16 55	16 45
	18	19 52	19 30	19 12	18 58	18 46	18 36	18 18	18 03	17 49	17 35	17 20	17 03	16 53	16 42
	22	20 00	19 36	19 18	19 03	18 50	18 39	18 21	18 05	17 50	17 35	17 19	17 01	16 51	16 39
	26	20 08	19 42	19 23	19 07	18 54	18 43	18 23	18 06	17 51	17 35	17 19	17 00	16 50	16 37
	30	20 15	19 48	19 28	19 12	18 58	18 46	18 26	18 08	17 52	17 36	17 19	17 00	16 49	16 36
	Dec. 4	20 21	19 54	19 32	19 16	19 01	18 49	18 28	18 10	17 54	17 37	17 20	17 00	16 48	16 35
		8	20 27	19 58	19 37	19 19	19 05	18 52	18 31	18 12	17 55	17 39	17 21	17 00	16 48
	12	20 32	20 02	19 40	19 23	19 08	18 55	18 33	18 15	17 57	17 40	17 22	17 01	16 49	16 35
	16	20 36	20 06	19 43	19 26	19 11	18 58	18 36	18 17	17 59	17 42	17 23	17 02	16 50	16 36
	20	20 39	20 09	19 46	19 28	19 13	19 00	18 38	18 19	18 01	17 44	17 25	17 04	16 51	16 37
	24	20 41	20 10	19 48	19 30	19 15	19 02	18 40	18 21	18 03	17 46	17 27	17 06	16 54	16 39
	28	20 41	20 11	19 49	19 31	19 16	19 03	18 41	18 23	18 05	17 48	17 29	17 08	16 56	16 42
	32	20 41	20 12	19 50	19 32	19 17	19 05	18 43	18 24	18 07	17 50	17 32	17 11	16 59	16 45
	36	20 39	20 11	19 49	19 32	19 18	19 05	18 44	18 26	18 09	17 52	17 34	17 14	17 02	16 48

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 56	5 56	5 57	5 58	5 58	5 59	6 00	6 01	6 02	6 03	6 04	6 06	6 07	6 09
5	6 00	6 01	6 02	6 03	6 04	6 05	6 07	6 08	6 10	6 12	6 14	6 16	6 19	6 22
9	6 04	6 05	6 07	6 08	6 10	6 12	6 14	6 16	6 18	6 21	6 24	6 27	6 31	6 35
13	6 08	6 10	6 11	6 13	6 16	6 18	6 20	6 23	6 26	6 30	6 33	6 38	6 42	6 48
17	6 12	6 14	6 16	6 19	6 22	6 24	6 27	6 31	6 34	6 39	6 43	6 48	6 54	7 01
21	6 16	6 19	6 22	6 24	6 27	6 31	6 34	6 38	6 43	6 48	6 53	6 59	7 07	7 15
25	6 21	6 24	6 27	6 30	6 33	6 37	6 42	6 46	6 51	6 57	7 03	7 11	7 19	7 29
29	6 25	6 28	6 32	6 36	6 40	6 44	6 49	6 54	7 00	7 06	7 13	7 22	7 31	7 43
Nov. 2	6 30	6 33	6 37	6 41	6 46	6 51	6 56	7 02	7 08	7 15	7 24	7 33	7 44	7 57
6	6 34	6 38	6 42	6 47	6 52	6 57	7 03	7 10	7 17	7 25	7 34	7 45	7 57	8 12
10	6 39	6 43	6 48	6 53	6 58	7 04	7 10	7 17	7 25	7 34	7 44	7 56	8 10	8 27
14	6 43	6 48	6 53	6 58	7 04	7 10	7 17	7 25	7 34	7 43	7 54	8 07	8 23	8 42
18	6 48	6 53	6 58	7 04	7 10	7 17	7 24	7 33	7 42	7 52	8 04	8 19	8 36	8 57
22	6 53	6 58	7 03	7 09	7 16	7 23	7 31	7 40	7 50	8 01	8 14	8 30	8 48	9 12
26	6 57	7 02	7 08	7 15	7 22	7 29	7 37	7 47	7 57	8 09	8 23	8 40	9 01	9 27
30	7 01	7 07	7 13	7 20	7 27	7 35	7 44	7 53	8 04	8 17	8 32	8 50	9 12	9 42
Dec. 4	7 05	7 11	7 17	7 24	7 32	7 40	7 49	7 59	8 11	8 24	8 40	8 59	9 23	9 56
8	7 09	7 15	7 21	7 29	7 36	7 45	7 54	8 05	8 17	8 31	8 47	9 07	9 33	10 09
12	7 12	7 18	7 25	7 32	7 40	7 49	7 59	8 09	8 22	8 36	8 53	9 14	9 41	10 20
16	7 15	7 21	7 28	7 35	7 44	7 52	8 02	8 13	8 26	8 40	8 58	9 19	9 47	10 28
20	7 17	7 24	7 31	7 38	7 46	7 55	8 05	8 16	8 29	8 44	9 01	9 23	9 51	10 34
24	7 19	7 26	7 33	7 40	7 48	7 57	8 07	8 18	8 31	8 46	9 03	9 25	9 53	10 36
28	7 21	7 27	7 34	7 41	7 49	7 58	8 08	8 19	8 32	8 46	9 04	9 25	9 53	10 34
32	7 22	7 28	7 35	7 42	7 50	7 59	8 08	8 19	8 31	8 46	9 03	9 23	9 50	10 29
36	7 22	7 28	7 35	7 42	7 50	7 58	8 07	8 18	8 30	8 44	9 00	9 20	9 45	10 21

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	17 43	17 42	17 42	17 41	17 40	17 39	17 38	17 37	17 36	17 35	17 34	17 32	17 31	17 29
5	17 37	17 36	17 35	17 33	17 32	17 31	17 29	17 28	17 26	17 24	17 22	17 19	17 17	17 13
9	17 30	17 29	17 27	17 26	17 24	17 22	17 20	17 18	17 16	17 13	17 10	17 07	17 03	16 58
13	17 24	17 22	17 20	17 18	17 16	17 14	17 11	17 08	17 05	17 02	16 58	16 54	16 49	16 43
17	17 18	17 16	17 14	17 11	17 09	17 06	17 03	16 59	16 55	16 51	16 46	16 41	16 35	16 28
21	17 12	17 10	17 07	17 04	17 01	16 58	16 54	16 50	16 46	16 41	16 35	16 29	16 21	16 13
25	17 07	17 04	17 01	16 58	16 54	16 50	16 46	16 41	16 36	16 30	16 24	16 17	16 08	15 58
29	17 02	16 59	16 55	16 51	16 47	16 43	16 38	16 33	16 27	16 20	16 13	16 05	15 55	15 43
Nov. 2	16 57	16 53	16 49	16 45	16 41	16 36	16 31	16 25	16 18	16 11	16 03	15 53	15 42	15 29
6	16 53	16 49	16 44	16 40	16 35	16 29	16 23	16 17	16 10	16 02	15 52	15 42	15 29	15 14
10	16 48	16 44	16 40	16 35	16 29	16 23	16 17	16 10	16 02	15 53	15 43	15 31	15 17	15 00
14	16 45	16 40	16 35	16 30	16 24	16 18	16 11	16 03	15 54	15 45	15 34	15 21	15 05	14 46
18	16 42	16 37	16 31	16 26	16 20	16 13	16 05	15 57	15 48	15 37	15 25	15 11	14 54	14 32
22	16 39	16 34	16 28	16 22	16 16	16 08	16 01	15 52	15 42	15 30	15 17	15 02	14 43	14 19
26	16 37	16 32	16 26	16 19	16 12	16 05	15 56	15 47	15 37	15 25	15 10	14 54	14 33	14 06
30	16 36	16 30	16 24	16 17	16 10	16 02	15 53	15 43	15 32	15 19	15 05	14 47	14 24	13 55
Dec. 4	16 35	16 29	16 22	16 16	16 08	16 00	15 51	15 40	15 29	15 15	15 00	14 41	14 17	13 44
8	16 35	16 28	16 22	16 15	16 07	15 58	15 49	15 38	15 26	15 13	14 56	14 36	14 11	13 34
12	16 35	16 29	16 22	16 15	16 07	15 58	15 48	15 38	15 25	15 11	14 54	14 33	14 06	13 27
16	16 36	16 29	16 23	16 15	16 07	15 58	15 49	15 38	15 25	15 10	14 53	14 32	14 04	13 22
20	16 37	16 31	16 24	16 17	16 09	16 00	15 50	15 39	15 26	15 11	14 54	14 32	14 04	13 21
24	16 39	16 33	16 26	16 19	16 11	16 02	15 52	15 41	15 28	15 13	14 56	14 34	14 06	13 23
28	16 42	16 36	16 29	16 21	16 13	16 05	15 55	15 44	15 31	15 17	14 59	14 38	14 10	13 29
32	16 45	16 39	16 32	16 25	16 17	16 08	15 59	15 48	15 35	15 21	15 04	14 44	14 17	13 38
36	16 48	16 42	16 36	16 29	16 21	16 13	16 03	15 53	15 41	15 27	15 11	14 51	14 25	13 50

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	0 05	0 28	0 46	1 01	1 14	1 25	1 44	2 01	2 16	2 32	2 49	3 08	3 20	3 33
1	0 39	1 07	1 28	1 46	2 00	2 13	2 35	2 54	3 12	3 30	3 49	4 12	4 25	4 40
2	1 24	1 55	2 18	2 37	2 53	3 06	3 29	3 50	4 09	4 27	4 48	5 11	5 25	5 41
3	2 22	2 53	3 16	3 34	3 50	4 03	4 26	4 46	5 05	5 23	5 43	6 06	6 19	6 35
4	3 30	3 58	4 19	4 36	4 50	5 02	5 23	5 41	5 58	6 15	6 33	6 54	7 06	7 20
5	4 45	5 07	5 25	5 39	5 51	6 01	6 19	6 35	6 49	7 04	7 19	7 37	7 47	7 59
6	6 00	6 17	6 30	6 41	6 51	6 59	7 13	7 25	7 37	7 48	8 00	8 14	8 22	8 31
7	7 14	7 26	7 35	7 43	7 49	7 55	8 05	8 13	8 21	8 29	8 38	8 47	8 53	8 59
8	8 27	8 33	8 38	8 42	8 46	8 49	8 54	8 59	9 03	9 08	9 13	9 18	9 21	9 25
9	9 38	9 39	9 40	9 40	9 41	9 42	9 43	9 43	9 44	9 45	9 46	9 47	9 48	9 48
10	10 48	10 44	10 41	10 38	10 36	10 34	10 30	10 27	10 25	10 22	10 19	10 16	10 14	10 12
11	11 58	11 49	11 42	11 36	11 31	11 26	11 19	11 12	11 05	10 59	10 52	10 45	10 41	10 36
12	13 10	12 56	12 45	12 35	12 27	12 20	12 08	11 58	11 48	11 38	11 28	11 16	11 09	11 02
13	14 24	14 04	13 48	13 36	13 25	13 16	13 00	12 46	12 33	12 20	12 06	11 50	11 41	11 31
14	15 38	15 12	14 53	14 37	14 24	14 13	13 53	13 36	13 21	13 05	12 48	12 29	12 18	12 05
15	16 49	16 20	15 57	15 40	15 24	15 11	14 49	14 30	14 12	13 55	13 36	13 14	13 01	12 47
16	17 54	17 23	16 59	16 40	16 24	16 10	15 47	15 26	15 08	14 49	14 29	14 05	13 52	13 36
17	18 48	18 17	17 54	17 36	17 20	17 07	16 44	16 24	16 05	15 47	15 27	15 04	14 50	14 35
18	19 29	19 02	18 42	18 26	18 12	18 00	17 39	17 21	17 04	16 47	16 29	16 08	15 55	15 41
19	19 59	19 38	19 22	19 09	18 58	18 48	18 31	18 16	18 02	17 48	17 33	17 15	17 05	16 53
20	20 22	20 08	19 56	19 47	19 39	19 32	19 19	19 08	18 58	18 48	18 37	18 24	18 16	18 08
21	20 40	20 32	20 26	20 20	20 16	20 11	20 04	19 58	19 52	19 46	19 39	19 32	19 28	19 23
22	20 56	20 54	20 53	20 51	20 50	20 49	20 47	20 46	20 44	20 43	20 41	20 39	20 38	20 37
23	21 12	21 16	21 19	21 21	21 24	21 26	21 29	21 33	21 36	21 39	21 42	21 46	21 48	21 51
24	21 28	21 38	21 46	21 52	21 58	22 03	22 12	22 20	22 27	22 34	22 42	22 52	22 57	23 03

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	17 10	16 43	16 22	16 05	15 51	15 39	15 18	15 00	14 43	14 26	14 08	13 47	13 35	13 21	
1	18 22	17 51	17 28	17 10	16 54	16 40	16 18	15 58	15 39	15 20	15 01	14 38	14 24	14 09	
2	19 20	18 49	18 26	18 07	17 52	17 38	17 15	16 54	16 36	16 17	15 56	15 33	15 19	15 03	
3	20 04	19 36	19 14	18 57	18 42	18 30	18 08	17 49	17 31	17 13	16 54	16 31	16 18	16 03	
4	20 36	20 12	19 54	19 39	19 26	19 15	18 56	18 39	18 23	18 07	17 50	17 31	17 19	17 06	
5	20 59	20 41	20 26	20 14	20 04	19 55	19 39	19 25	19 12	18 59	18 45	18 29	18 20	18 09	
6	21 17	21 04	20 53	20 45	20 37	20 30	20 18	20 08	19 58	19 49	19 38	19 26	19 19	19 11	
7	21 31	21 23	21 17	21 11	21 06	21 02	20 55	20 48	20 42	20 36	20 29	20 21	20 17	20 11	
8	21 44	21 41	21 38	21 36	21 34	21 32	21 29	21 26	21 23	21 21	21 18	21 14	21 13	21 10	
9	21 56	21 57	21 58	21 59	22 00	22 00	22 02	22 03	22 04	22 05	22 06	22 07	22 08	22 08	
10	22 07	22 14	22 18	22 23	22 26	22 29	22 35	22 40	22 44	22 49	22 54	22 59	23 02	23 06	
11	22 20	22 31	22 40	22 47	22 54	22 59	23 09	23 18	23 26	23 34	23 42	23 52	23 58	.. ..
12	22 36	22 52	23 04	23 15	23 24	23 32	23 46	23 58	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	
13	22 55	23 16	23 33	23 46	23 58	.. ..	.. ..	.. ..	0 09	0 20	0 33	0 47	0 55	1 04	
14	23 21	23 47	.. ..	.. ..	.. ..	0 08	0 26	0 41	0 55	1 10	1 25	1 43	1 53	2 05	
15	23 57	.. ..	0 07	0 24	0 37	0 50	1 10	1 28	1 45	2 02	2 20	2 41	2 53	3 07	
16	.. ..	0 27	0 50	1 09	1 24	1 37	2 00	2 20	2 38	2 57	3 17	3 40	3 53	4 08	
17	0 48	1 20	1 43	2 02	2 18	2 32	2 56	3 16	3 35	3 54	4 14	4 37	4 51	5 07	
18	1 54	2 24	2 47	3 05	3 20	3 33	3 56	4 15	4 33	4 51	5 10	5 32	5 45	6 00	
19	3 15	3 40	3 59	4 15	4 28	4 39	4 59	5 16	5 32	5 47	6 04	6 23	6 34	6 46	
20	4 43	5 02	5 17	5 29	5 39	5 48	6 03	6 16	6 29	6 41	6 54	7 09	7 17	7 27	
21	6 14	6 26	6 36	6 44	6 51	6 56	7 07	7 16	7 24	7 32	7 41	7 50	7 56	8 02	
22	7 45	7 51	7 55	7 58	8 02	8 04	8 09	8 13	8 17	8 21	8 24	8 29	8 31	8 34	
23	9 15	9 14	9 13	9 12	9 12	9 11	9 10	9 09	9 09	9 08	9 07	9 06	9 05	9 05	
24	10 43	10 36	10 30	10 25	10 21	10 17	10 11	10 05	10 00	9 55	9 49	9 43	9 39	9 35	

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	3 33	3 39	3 45	3 52	4 00	4 08	4 17	4 28	4 40	4 53	5 09	5 29	5 53	6 27
1	4 40	4 47	4 54	5 02	5 11	5 20	5 31	5 44	5 58	6 14	6 34	6 59	7 34	8 39
2	5 41	5 48	5 56	6 04	6 14	6 24	6 35	6 48	7 03	7 21	7 43	8 11	8 52	■
3	6 35	6 42	6 49	6 57	7 06	7 16	7 27	7 39	7 54	8 10	8 31	8 56	9 31	10 35
4	7 20	7 27	7 33	7 41	7 48	7 57	8 07	8 18	8 30	8 44	9 00	9 21	9 46	10 21
5	7 59	8 04	8 09	8 15	8 22	8 29	8 37	8 46	8 55	9 06	9 19	9 34	9 52	10 14
6	8 31	8 35	8 39	8 44	8 49	8 54	9 00	9 07	9 14	9 22	9 31	9 42	9 54	10 09
7	8 59	9 02	9 05	9 08	9 12	9 15	9 19	9 24	9 29	9 34	9 40	9 47	9 55	10 04
8	9 25	9 26	9 28	9 29	9 31	9 33	9 36	9 38	9 41	9 43	9 47	9 50	9 55	9 59
9	9 48	9 49	9 49	9 49	9 50	9 50	9 50	9 51	9 51	9 52	9 53	9 53	9 54	9 55
10	10 12	10 11	10 10	10 09	10 08	10 06	10 05	10 04	10 02	10 00	9 58	9 56	9 54	9 51
11	10 36	10 34	10 31	10 29	10 26	10 23	10 20	10 17	10 13	10 09	10 04	9 59	9 53	9 46
12	11 02	10 58	10 55	10 51	10 47	10 42	10 37	10 32	10 26	10 19	10 12	10 03	9 54	9 42
13	11 31	11 27	11 22	11 16	11 11	11 05	10 58	10 50	10 42	10 33	10 22	10 10	9 55	9 38
14	12 05	12 00	11 54	11 47	11 40	11 32	11 24	11 14	11 04	10 51	10 37	10 20	10 00	9 33
15	12 47	12 40	12 33	12 25	12 17	12 08	11 58	11 46	11 33	11 18	11 00	10 38	10 10	9 28
16	13 36	13 29	13 21	13 13	13 04	12 54	12 43	12 30	12 16	11 59	11 38	11 12	10 35	9 19
17	14 35	14 28	14 20	14 12	14 03	13 53	13 42	13 29	13 15	12 57	12 37	12 10	11 33	10 10
18	15 41	15 35	15 28	15 21	15 12	15 03	14 53	14 42	14 29	14 15	13 57	13 35	13 07	12 25
19	16 53	16 48	16 43	16 37	16 30	16 23	16 15	16 06	15 56	15 45	15 31	15 15	14 56	14 32
20	18 08	18 04	18 00	17 56	17 51	17 46	17 41	17 35	17 28	17 20	17 11	17 01	16 49	16 34
21	19 23	19 21	19 19	19 16	19 14	19 11	19 08	19 04	19 00	18 56	18 51	18 46	18 39	18 32
22	20 37	20 37	20 36	20 36	20 35	20 34	20 34	20 33	20 32	20 31	20 30	20 29	20 27	20 26
23	21 51	21 52	21 53	21 54	21 56	21 57	21 59	22 01	22 03	22 05	22 07	22 10	22 14	22 17
24	23 03	23 06	23 09	23 12	23 15	23 19	23 23	23 27	23 32	23 38	23 44	23 51	23 59	...

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	13 21	13 15	13 08	13 01	12 53	12 44	12 35	12 24	12 12	11 58	11 41	11 21	10 56	10 21
1	14 09	14 02	13 54	13 46	13 37	13 27	13 16	13 04	12 49	12 33	12 13	11 47	11 12	10 07
2	15 03	14 56	14 48	14 40	14 31	14 20	14 09	13 56	13 41	13 23	13 01	12 33	11 53	■
3	16 03	15 56	15 49	15 41	15 32	15 22	15 12	14 59	14 45	14 29	14 09	13 44	13 09	12 05
4	17 06	17 00	16 53	16 46	16 39	16 30	16 21	16 11	15 59	15 45	15 29	15 10	14 45	14 10
5	18 09	18 04	17 59	17 53	17 47	17 41	17 33	17 25	17 16	17 05	16 53	16 39	16 22	16 00
6	19 11	19 08	19 04	19 00	18 55	18 50	18 45	18 39	18 33	18 25	18 17	18 07	17 56	17 42
7	20 11	20 09	20 07	20 04	20 01	19 58	19 55	19 51	19 47	19 43	19 38	19 32	19 25	19 17
8	21 10	21 09	21 08	21 07	21 06	21 05	21 03	21 02	21 00	20 58	20 56	20 54	20 51	20 48
9	22 08	22 09	22 09	22 09	22 10	22 10	22 11	22 11	22 12	22 12	22 13	22 14	22 15	22 16
10	23 06	23 08	23 09	23 11	23 13	23 15	23 18	23 20	23 23	23 26	23 30	23 34	23 39	23 44
11	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	0 04	0 07	0 10	0 14	0 17	0 21	0 25	0 30	0 35	0 41	0 48	0 55	1 04	1 15
13	1 04	1 08	1 13	1 17	1 23	1 28	1 34	1 41	1 49	1 58	2 08	2 19	2 33	2 50
14	2 05	2 11	2 16	2 22	2 29	2 37	2 45	2 54	3 04	3 16	3 29	3 46	4 06	4 31
15	3 07	3 13	3 20	3 28	3 36	3 45	3 54	4 06	4 18	4 33	4 51	5 12	5 40	6 22
16	4 08	4 15	4 23	4 31	4 40	4 50	5 01	5 13	5 28	5 45	6 05	6 31	7 08	8 24
17	5 07	5 14	5 21	5 30	5 39	5 49	6 00	6 13	6 27	6 45	7 05	7 32	8 09	9 32
18	6 00	6 06	6 13	6 21	6 29	6 39	6 49	7 00	7 14	7 29	7 47	8 09	8 38	9 21
19	6 46	6 52	6 58	7 04	7 11	7 19	7 28	7 37	7 47	8 00	8 13	8 30	8 50	9 15
20	7 27	7 31	7 36	7 40	7 46	7 51	7 58	8 05	8 12	8 21	8 31	8 42	8 55	9 11
21	8 02	8 05	8 08	8 11	8 14	8 18	8 22	8 27	8 31	8 37	8 43	8 50	8 57	9 06
22	8 34	8 35	8 37	8 38	8 40	8 41	8 43	8 45	8 47	8 49	8 52	8 55	8 58	9 02
23	9 05	9 04	9 04	9 04	9 03	9 03	9 02	9 02	9 01	9 01	9 00	9 00	8 59	8 58
24	9 35	9 33	9 31	9 29	9 27	9 24	9 22	9 19	9 16	9 12	9 08	9 04	8 59	8 53

■ indicates Moon continuously below horizon.

... indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	21 12	21 16	21 19	21 21	21 24	21 26	21 29	21 33	21 36	21 39	21 42	21 46	21 48	21 51
24	21 28	21 38	21 46	21 52	21 58	22 03	22 12	22 20	22 27	22 34	22 42	22 52	22 57	23 03
25	21 47	22 02	22 15	22 25	22 34	22 42	22 56	23 08	23 19	23 31	23 43	23 57	.. ..	.. ..
26	22 10	22 32	22 48	23 02	23 14	23 24	23 42	23 58	.. ..	.. ..	.. ..	.. ..	0 05	0 15
27	22 41	23 07	23 28	23 44	23 59	.. ..	.. ..	.. ..	0 13	0 28	0 43	1 02	1 13	1 25
28	23 21	23 52	.. ..	.. ..	.. ..	0 11	0 32	0 50	1 08	1 25	1 44	2 05	2 18	2 32
29	.. ..	.. ..	0 14	0 33	0 48	1 02	1 25	1 45	2 03	2 22	2 42	3 05	3 19	3 35
30	0 14	0 45	1 09	1 27	1 43	1 57	2 20	2 40	2 58	3 17	3 37	4 01	4 14	4 30
31	1 18	1 47	2 09	2 26	2 41	2 54	3 16	3 35	3 52	4 10	4 29	4 50	5 03	5 17
Feb. 1	2 30	2 54	3 13	3 28	3 41	3 52	4 11	4 28	4 43	4 59	5 15	5 34	5 45	5 58
2	3 44	4 03	4 18	4 30	4 41	4 50	5 05	5 19	5 31	5 44	5 58	6 13	6 22	6 32
3	4 58	5 12	5 23	5 32	5 39	5 46	5 57	6 07	6 17	6 26	6 36	6 47	6 54	7 01
4	6 11	6 19	6 26	6 32	6 36	6 40	6 48	6 54	7 00	7 06	7 12	7 19	7 23	7 28
5	7 23	7 26	7 28	7 30	7 32	7 34	7 36	7 39	7 41	7 43	7 46	7 49	7 50	7 52
6	8 33	8 31	8 29	8 28	8 27	8 26	8 24	8 23	8 22	8 20	8 19	8 17	8 17	8 16
7	9 43	9 36	9 31	9 26	9 22	9 18	9 12	9 07	9 02	8 57	8 52	8 46	8 43	8 39
8	10 54	10 42	10 32	10 24	10 17	10 11	10 01	9 52	9 44	9 35	9 27	9 17	9 11	9 04
9	12 06	11 48	11 35	11 23	11 14	11 05	10 51	10 39	10 27	10 15	10 03	9 49	9 41	9 32
10	13 18	12 55	12 38	12 23	12 11	12 01	11 43	11 27	11 13	10 58	10 43	10 25	10 15	10 04
11	14 29	14 02	13 41	13 24	13 10	12 57	12 37	12 18	12 02	11 45	11 27	11 06	10 54	10 41
12	15 36	15 05	14 42	14 23	14 08	13 55	13 32	13 12	12 54	12 35	12 16	11 53	11 40	11 25
13	16 34	16 02	15 39	15 20	15 04	14 51	14 27	14 07	13 49	13 30	13 10	12 47	12 33	12 17
14	17 20	16 51	16 30	16 12	15 57	15 44	15 22	15 03	14 45	14 28	14 08	13 46	13 33	13 18
15	17 55	17 32	17 13	16 58	16 46	16 34	16 15	15 59	15 43	15 27	15 11	14 51	14 40	14 27
16	18 22	18 04	17 51	17 39	17 29	17 20	17 05	16 52	16 40	16 28	16 14	15 59	15 50	15 40

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	9 15	9 14	9 13	9 12	9 12	9 11	9 10	9 09	9 09	9 08	9 07	9 06	9 05	9 05
24	10 43	10 36	10 30	10 25	10 21	10 17	10 11	10 05	10 00	9 55	9 49	9 43	9 39	9 35
25	12 11	11 57	11 46	11 37	11 30	11 23	11 11	11 01	10 52	10 42	10 32	10 21	10 14	10 07
26	13 37	13 17	13 01	12 48	12 38	12 28	12 12	11 58	11 44	11 31	11 17	11 01	10 52	10 41
27	14 59	14 33	14 13	13 58	13 44	13 32	13 12	12 55	12 39	12 23	12 05	11 46	11 34	11 21
28	16 13	15 43	15 21	15 03	14 47	14 34	14 12	13 52	13 34	13 16	12 57	12 34	12 21	12 06
29	17 15	16 44	16 20	16 02	15 46	15 32	15 09	14 49	14 30	14 11	13 51	13 27	13 14	12 58
30	18 03	17 33	17 11	16 53	16 38	16 25	16 02	15 43	15 25	15 06	14 46	14 24	14 10	13 55
31	18 38	18 13	17 53	17 37	17 24	17 12	16 51	16 34	16 17	16 00	15 42	15 22	15 10	14 56
Feb. 1	19 04	18 43	18 27	18 14	18 03	17 53	17 36	17 21	17 07	16 53	16 37	16 20	16 10	15 58
2	19 23	19 08	18 56	18 46	18 37	18 30	18 16	18 05	17 54	17 43	17 31	17 17	17 09	17 00
3	19 39	19 29	19 21	19 14	19 08	19 03	18 53	18 45	18 38	18 30	18 22	18 12	18 07	18 01
4	19 52	19 47	19 43	19 39	19 36	19 33	19 28	19 24	19 20	19 16	19 11	19 06	19 03	19 00
5	20 04	20 04	20 03	20 03	20 03	20 02	20 02	20 01	20 01	20 00	20 00	19 59	19 59	19 58
6	20 16	20 20	20 24	20 26	20 29	20 31	20 35	20 38	20 41	20 44	20 48	20 51	20 54	20 56
7	20 29	20 38	20 45	20 51	20 56	21 00	21 08	21 15	21 22	21 29	21 36	21 44	21 49	21 54
8	20 43	20 57	21 08	21 17	21 25	21 32	21 44	21 54	22 04	22 14	22 25	22 37	22 44	22 53
9	21 00	21 19	21 34	21 46	21 57	22 06	22 22	22 36	22 49	23 02	23 16	23 32	23 41	23 52
10	21 23	21 47	22 05	22 20	22 33	22 44	23 03	23 20	23 36	23 52	.. ..	.. ..	.. ..	.. ..
11	21 53	22 21	22 43	23 00	23 15	23 28	23 50	.. ..	.. ..	.. ..	0 08	0 28	0 39	0 52
12	22 35	23 06	23 30	23 48	.. ..	.. ..	.. ..	0 08	0 26	0 44	1 03	1 25	1 38	1 53
13	23 32	.. ..	.. ..	.. ..	0 04	0 18	0 41	1 01	1 20	1 38	1 58	2 22	2 35	2 51
14	.. ..	0 03	0 27	0 45	1 01	1 14	1 37	1 57	2 16	2 34	2 54	3 17	3 30	3 45
15	0 44	1 12	1 33	1 50	2 04	2 17	2 38	2 56	3 13	3 30	3 48	4 08	4 20	4 34
16	2 08	2 30	2 47	3 01	3 13	3 23	3 41	3 56	4 10	4 24	4 39	4 56	5 06	5 17

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	21 51	21 52	21 53	21 54	21 56	21 57	21 59	22 01	22 03	22 05	22 07	22 10	22 14	22 17
24	23 03	23 06	23 09	23 12	23 15	23 19	23 23	23 27	23 32	23 38	23 44	23 51	23 59	...
25	...	...	...	...	...	...	...	...	...	...	...	...	...	0 09
26	0 15	0 19	0 24	0 28	0 34	0 39	0 46	0 53	1 01	1 10	1 20	1 32	1 46	2 03
27	1 25	1 31	1 37	1 43	1 50	1 58	2 06	2 16	2 27	2 39	2 54	3 11	3 33	4 02
28	2 32	2 39	2 46	2 54	3 02	3 11	3 22	3 33	3 47	4 02	4 21	4 45	5 16	6 06
29	3 35	3 42	3 49	3 58	4 07	4 17	4 28	4 41	4 56	5 13	5 35	6 02	6 42	■
30	4 30	4 37	4 45	4 53	5 02	5 12	5 23	5 36	5 50	6 08	6 29	6 55	7 33	9 02
31	5 17	5 24	5 31	5 39	5 47	5 56	6 06	6 18	6 31	6 46	7 03	7 25	7 54	8 36
Feb. 1	5 58	6 03	6 09	6 16	6 23	6 31	6 39	6 49	6 59	7 11	7 25	7 42	8 03	8 29
2	6 32	6 36	6 41	6 46	6 52	6 58	7 05	7 12	7 20	7 29	7 40	7 52	8 06	8 23
3	7 01	7 05	7 08	7 12	7 16	7 20	7 25	7 30	7 36	7 42	7 50	7 58	8 08	8 19
4	7 28	7 30	7 32	7 34	7 37	7 39	7 42	7 45	7 49	7 53	7 57	8 02	8 08	8 14
5	7 52	7 53	7 54	7 55	7 56	7 57	7 58	7 59	8 00	8 02	8 03	8 05	8 08	8 10
6	8 16	8 15	8 15	8 14	8 14	8 13	8 12	8 12	8 11	8 10	8 09	8 08	8 07	8 06
7	8 39	8 38	8 36	8 34	8 32	8 30	8 27	8 25	8 22	8 19	8 15	8 11	8 07	8 02
8	9 04	9 02	8 59	8 55	8 52	8 48	8 44	8 39	8 34	8 29	8 22	8 15	8 07	7 58
9	9 32	9 28	9 24	9 19	9 14	9 09	9 03	8 56	8 49	8 41	8 31	8 21	8 08	7 54
10	10 04	9 58	9 53	9 47	9 40	9 33	9 26	9 17	9 08	8 57	8 44	8 29	8 12	7 50
11	10 41	10 35	10 28	10 21	10 13	10 05	9 55	9 45	9 33	9 19	9 03	8 43	8 19	7 46
12	11 25	11 18	11 11	11 03	10 54	10 44	10 34	10 22	10 08	9 52	9 32	9 08	8 36	7 43
13	12 17	12 10	12 03	11 54	11 45	11 35	11 24	11 12	10 57	10 40	10 19	9 53	9 15	7 50
14	13 18	13 12	13 05	12 57	12 48	12 39	12 28	12 16	12 02	11 46	11 27	11 03	10 30	9 35
15	14 27	14 21	14 15	14 08	14 00	13 52	13 43	13 33	13 22	13 09	12 53	12 34	12 11	11 39
16	15 40	15 35	15 31	15 25	15 20	15 13	15 07	14 59	14 50	14 41	14 30	14 17	14 01	13 42

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	9 05	9 04	9 04	9 04	9 03	9 03	9 02	9 02	9 01	9 01	9 00	9 00	8 59	8 58
24	9 35	9 33	9 31	9 29	9 27	9 24	9 22	9 19	9 16	9 12	9 08	9 04	8 59	8 53
25	10 07	10 03	10 00	9 56	9 52	9 48	9 43	9 38	9 32	9 25	9 18	9 10	9 00	8 49
26	10 41	10 37	10 32	10 26	10 21	10 14	10 07	10 00	9 51	9 41	9 30	9 17	9 02	8 44
27	11 21	11 15	11 09	11 02	10 54	10 46	10 37	10 27	10 16	10 03	9 48	9 30	9 07	8 38
28	12 06	11 59	11 52	11 44	11 36	11 26	11 16	11 04	10 50	10 34	10 15	9 51	9 20	8 29
29	12 58	12 51	12 43	12 35	12 25	12 15	12 04	11 51	11 36	11 18	10 57	10 30	9 50	■
30	13 55	13 48	13 40	13 32	13 23	13 13	13 02	12 50	12 35	12 18	11 57	11 31	10 54	9 24
31	14 56	14 49	14 42	14 35	14 27	14 18	14 08	13 57	13 45	13 30	13 12	12 51	12 23	11 41
Feb. 1	15 58	15 53	15 47	15 41	15 34	15 27	15 19	15 10	15 00	14 48	14 34	14 18	13 58	13 33
2	17 00	16 56	16 51	16 47	16 42	16 36	16 30	16 23	16 16	16 07	15 57	15 46	15 33	15 16
3	18 01	17 58	17 55	17 52	17 48	17 44	17 40	17 36	17 31	17 25	17 19	17 12	17 03	16 53
4	19 00	18 59	18 57	18 55	18 53	18 51	18 49	18 47	18 44	18 41	18 38	18 34	18 30	18 25
5	19 58	19 58	19 58	19 58	19 57	19 57	19 57	19 57	19 56	19 56	19 56	19 55	19 55	19 54
6	20 56	20 57	20 58	21 00	21 01	21 02	21 04	21 06	21 08	21 10	21 12	21 15	21 18	21 22
7	21 54	21 56	21 59	22 02	22 05	22 08	22 11	22 15	22 19	22 24	22 29	22 35	22 42	22 51
8	22 53	22 56	23 00	23 04	23 09	23 14	23 19	23 25	23 32	23 39	23 47	23 57	...	...
9	23 52	23 57	...	...	...	...	...	...	...	...	...	...	0 09	0 23
10	...	...	0 02	0 08	0 14	0 20	0 28	0 36	0 45	0 55	1 07	1 21	1 38	1 59
11	0 52	0 58	1 05	1 11	1 19	1 27	1 36	1 46	1 58	2 11	2 27	2 46	3 10	3 42
12	1 53	1 59	2 06	2 14	2 23	2 32	2 43	2 54	3 08	3 24	3 43	4 07	4 39	5 32
13	2 51	2 58	3 05	3 14	3 23	3 33	3 44	3 56	4 11	4 28	4 49	5 15	5 53	7 18
14	3 45	3 52	3 59	4 07	4 16	4 26	4 37	4 49	5 03	5 19	5 38	6 03	6 36	7 31
15	4 34	4 40	4 47	4 54	5 02	5 10	5 20	5 30	5 42	5 56	6 12	6 31	6 55	7 28
16	5 17	5 22	5 28	5 34	5 40	5 46	5 54	6 02	6 11	6 22	6 34	6 47	7 04	7 24

■ indicates Moon continuously below horizon.

... indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	17 55	17 32	17 13	16 58	16 46	16 34	16 15	15 59	15 43	15 27	15 11	14 51	14 40	14 27
16	18 22	18 04	17 51	17 39	17 29	17 20	17 05	16 52	16 40	16 28	16 14	15 59	15 50	15 40
17	18 43	18 32	18 23	18 15	18 09	18 03	17 53	17 44	17 36	17 27	17 18	17 08	17 02	16 56
18	19 01	18 56	18 52	18 48	18 45	18 43	18 38	18 34	18 30	18 26	18 22	18 18	18 15	18 12
19	19 17	19 18	19 19	19 20	19 20	19 21	19 22	19 23	19 24	19 24	19 25	19 27	19 27	19 28
20	19 34	19 41	19 47	19 52	19 56	19 59	20 06	20 12	20 17	20 23	20 28	20 35	20 39	20 44
21	19 53	20 06	20 16	20 25	20 33	20 39	20 51	21 01	21 11	21 21	21 31	21 44	21 51	21 59
22	20 15	20 34	20 49	21 02	21 13	21 22	21 38	21 53	22 06	22 20	22 34	22 51	23 01	23 12
23	20 44	21 09	21 28	21 43	21 57	22 08	22 28	22 46	23 02	23 19	23 36	23 57	.. ..	.. ..
24	21 22	21 51	22 13	22 31	22 46	22 59	23 21	23 41	23 59	.. ..	.. ..	.. ..	0 09	0 23
25	22 11	22 42	23 05	23 24	23 39	23 53	.. ..	.. ..	.. ..	0 17	0 37	0 59	1 12	1 28
26	23 12	23 41	.. ..	.. ..	.. ..	.. ..	0 16	0 36	0 55	1 13	1 33	1 56	2 10	2 26
27	.. ..	.. ..	0 04	0 21	0 36	0 49	1 12	1 31	1 49	2 07	2 26	2 48	3 01	3 16
28	0 21	0 46	1 06	1 22	1 35	1 47	2 07	2 24	2 40	2 56	3 14	3 33	3 45	3 58
Mar. 1	1 33	1 54	2 10	2 23	2 34	2 44	3 01	3 15	3 29	3 42	3 57	4 13	4 23	4 34
2	2 47	3 02	3 14	3 24	3 33	3 40	3 53	4 04	4 15	4 25	4 36	4 49	4 56	5 04
3	3 59	4 09	4 17	4 24	4 30	4 35	4 43	4 51	4 58	5 05	5 13	5 21	5 26	5 32
4	5 11	5 15	5 19	5 23	5 26	5 28	5 32	5 36	5 40	5 43	5 47	5 51	5 54	5 56
5	6 21	6 21	6 21	6 21	6 21	6 21	6 20	6 20	6 20	6 20	6 20	6 20	6 20	6 20
6	7 31	7 26	7 22	7 18	7 15	7 13	7 08	7 05	7 01	6 57	6 54	6 49	6 47	6 44
7	8 41	8 31	8 23	8 16	8 11	8 05	7 57	7 49	7 42	7 35	7 28	7 19	7 14	7 09
8	9 52	9 37	9 25	9 15	9 06	8 59	8 46	8 35	8 25	8 14	8 03	7 51	7 44	7 36
9	11 04	10 43	10 27	10 14	10 03	9 53	9 37	9 23	9 09	8 56	8 42	8 26	8 16	8 06
10	12 14	11 49	11 30	11 14	11 00	10 49	10 29	10 12	9 56	9 40	9 24	9 04	8 53	8 40
11	13 21	12 52	12 30	12 12	11 58	11 45	11 23	11 04	10 46	10 28	10 10	9 48	9 35	9 21

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	0 44	1 12	1 33	1 50	2 04	2 17	2 38	2 56	3 13	3 30	3 48	4 08	4 20	4 34
16	2 08	2 30	2 47	3 01	3 13	3 23	3 41	3 56	4 10	4 24	4 39	4 56	5 06	5 17
17	3 38	3 53	4 06	4 16	4 24	4 32	4 45	4 56	5 07	5 17	5 28	5 40	5 48	5 56
18	5 10	5 19	5 26	5 32	5 37	5 41	5 49	5 55	6 02	6 08	6 14	6 21	6 25	6 30
19	6 43	6 45	6 47	6 48	6 49	6 50	6 52	6 54	6 55	6 57	6 58	7 00	7 01	7 02
20	8 15	8 10	8 07	8 04	8 01	7 59	7 55	7 52	7 49	7 46	7 42	7 38	7 36	7 34
21	9 46	9 35	9 27	9 19	9 13	9 08	8 58	8 50	8 43	8 35	8 27	8 17	8 12	8 06
22	11 16	10 59	10 45	10 34	10 24	10 16	10 01	9 49	9 37	9 25	9 13	8 59	8 50	8 41
23	12 43	12 19	12 01	11 46	11 34	11 23	11 04	10 48	10 33	10 18	10 02	9 43	9 32	9 20
24	14 02	13 33	13 12	12 54	12 40	12 27	12 05	11 47	11 29	11 12	10 53	10 32	10 19	10 05
25	15 08	14 38	14 15	13 56	13 41	13 27	13 04	12 44	12 26	12 07	11 47	11 24	11 11	10 55
26	16 01	15 31	15 08	14 50	14 35	14 22	13 59	13 39	13 21	13 02	12 43	12 20	12 06	11 51
27	16 40	16 13	15 53	15 36	15 22	15 10	14 49	14 31	14 14	13 57	13 38	13 17	13 04	12 50
28	17 08	16 46	16 29	16 15	16 03	15 53	15 35	15 19	15 04	14 49	14 33	14 15	14 04	13 51
Mar. 1	17 30	17 13	16 59	16 48	16 39	16 31	16 16	16 03	15 51	15 39	15 26	15 11	15 03	14 53
2	17 46	17 35	17 25	17 17	17 10	17 04	16 54	16 45	16 36	16 27	16 18	16 07	16 00	15 53
3	18 01	17 54	17 48	17 43	17 39	17 36	17 29	17 24	17 18	17 13	17 07	17 01	16 57	16 52
4	18 13	18 11	18 09	18 08	18 06	18 05	18 03	18 01	17 59	17 58	17 56	17 53	17 52	17 51
5	18 25	18 28	18 30	18 31	18 33	18 34	18 36	18 38	18 40	18 42	18 44	18 46	18 47	18 49
6	18 38	18 45	18 51	18 55	19 00	19 03	19 10	19 15	19 21	19 26	19 32	19 38	19 42	19 46
7	18 52	19 03	19 13	19 21	19 28	19 34	19 44	19 54	20 02	20 11	20 21	20 31	20 37	20 45
8	19 08	19 25	19 38	19 49	19 59	20 07	20 21	20 34	20 46	20 58	21 11	21 25	21 34	21 43
9	19 29	19 50	20 07	20 21	20 33	20 43	21 01	21 17	21 32	21 46	22 02	22 20	22 31	22 43
10	19 56	20 22	20 42	20 58	21 12	21 24	21 45	22 03	22 20	22 37	22 55	23 16	23 28	23 42
11	20 32	21 02	21 24	21 42	21 58	22 11	22 33	22 53	23 11	23 29	23 49	.. ..	.. ..	.. ..

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

37

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	14 27	14 21	14 15	14 08	14 00	13 52	13 43	13 33	13 22	13 09	12 53	12 34	12 11	11 39
16	15 40	15 35	15 31	15 25	15 20	15 13	15 07	14 59	14 50	14 41	14 30	14 17	14 01	13 42
17	16 56	16 53	16 49	16 46	16 42	16 38	16 34	16 29	16 24	16 17	16 11	16 03	15 53	15 43
18	18 12	18 11	18 09	18 08	18 06	18 04	18 02	18 00	17 58	17 55	17 52	17 49	17 45	17 40
19	19 28	19 28	19 29	19 29	19 30	19 30	19 30	19 31	19 32	19 32	19 33	19 34	19 35	19 36
20	20 44	20 46	20 48	20 50	20 53	20 55	20 58	21 02	21 05	21 09	21 14	21 19	21 25	21 32
21	21 59	22 02	22 06	22 10	22 15	22 20	22 25	22 31	22 38	22 45	22 54	23 04	23 15	23 29
22	23 12	23 17	23 23	23 29	23 35	23 42	23 50	23 58	...	...	...	...	...	...
23	...	...	...	...	...	...	...	...	0 08	0 19	0 32	0 47	1 06	1 29
24	0 23	0 29	0 36	0 43	0 51	0 59	1 09	1 20	1 33	1 47	2 04	2 25	2 52	3 32
25	1 28	1 35	1 42	1 50	1 59	2 09	2 20	2 32	2 47	3 04	3 24	3 50	4 26	5 39
26	2 26	2 33	2 40	2 49	2 58	3 08	3 19	3 32	3 46	4 04	4 25	4 51	5 29	■
27	3 16	3 22	3 30	3 37	3 46	3 55	4 06	4 17	4 31	4 46	5 05	5 28	5 59	6 46
28	3 58	4 04	4 10	4 17	4 24	4 32	4 41	4 51	5 03	5 16	5 31	5 49	6 11	6 41
Mar. 1	4 34	4 38	4 44	4 49	4 55	5 02	5 09	5 17	5 26	5 36	5 47	6 01	6 17	6 36
2	5 04	5 08	5 12	5 16	5 21	5 25	5 31	5 37	5 43	5 51	5 59	6 08	6 19	6 32
3	5 32	5 34	5 37	5 39	5 42	5 46	5 49	5 53	5 57	6 02	6 07	6 13	6 20	6 28
4	5 56	5 58	5 59	6 00	6 02	6 03	6 05	6 07	6 09	6 12	6 14	6 17	6 20	6 24
5	6 20	6 20	6 20	6 20	6 20	6 20	6 20	6 20	6 20	6 20	6 20	6 20	6 20	6 20
6	6 44	6 43	6 42	6 40	6 39	6 37	6 35	6 34	6 32	6 29	6 27	6 24	6 21	6 17
7	7 09	7 06	7 04	7 01	6 58	6 55	6 52	6 48	6 44	6 39	6 34	6 28	6 21	6 13
8	7 36	7 32	7 28	7 24	7 20	7 15	7 10	7 04	6 57	6 50	6 42	6 33	6 22	6 10
9	8 06	8 01	7 56	7 50	7 45	7 38	7 31	7 23	7 15	7 05	6 54	6 41	6 25	6 07
10	8 40	8 35	8 28	8 22	8 15	8 07	7 58	7 48	7 37	7 25	7 10	6 53	6 32	6 04
11	9 21	9 14	9 07	9 00	8 52	8 42	8 32	8 21	8 08	7 53	7 35	7 13	6 45	6 04

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	4 34	4 40	4 47	4 54	5 02	5 10	5 20	5 30	5 42	5 56	6 12	6 31	6 55	7 28
16	5 17	5 22	5 28	5 34	5 40	5 46	5 54	6 02	6 11	6 22	6 34	6 47	7 04	7 24
17	5 56	5 59	6 03	6 07	6 12	6 16	6 21	6 27	6 33	6 41	6 49	6 58	7 08	7 20
18	6 30	6 32	6 34	6 37	6 39	6 42	6 45	6 48	6 51	6 55	7 00	7 04	7 10	7 17
19	7 02	7 03	7 03	7 04	7 04	7 05	7 06	7 06	7 07	7 08	7 09	7 10	7 11	7 13
20	7 34	7 33	7 31	7 30	7 29	7 27	7 26	7 24	7 22	7 20	7 18	7 15	7 12	7 09
21	8 06	8 03	8 01	7 58	7 54	7 51	7 47	7 43	7 38	7 33	7 27	7 21	7 13	7 05
22	8 41	8 37	8 33	8 28	8 23	8 17	8 11	8 04	7 57	7 49	7 39	7 28	7 16	7 00
23	9 20	9 15	9 09	9 03	8 56	8 48	8 40	8 31	8 21	8 09	7 56	7 40	7 20	6 56
24	10 05	9 58	9 51	9 44	9 36	9 26	9 16	9 05	8 52	8 38	8 20	7 59	7 31	6 51
25	10 55	10 48	10 40	10 32	10 23	10 13	10 02	9 50	9 35	9 18	8 58	8 32	7 55	6 42
26	11 51	11 44	11 36	11 28	11 19	11 09	10 58	10 45	10 30	10 13	9 53	9 26	8 48	■
27	12 50	12 44	12 37	12 29	12 21	12 12	12 01	11 50	11 37	11 21	11 03	10 40	10 10	9 23
28	13 51	13 46	13 40	13 33	13 26	13 18	13 10	13 00	12 49	12 37	12 22	12 05	11 43	11 14
Mar. 1	14 53	14 48	14 43	14 38	14 33	14 27	14 20	14 13	14 04	13 55	13 44	13 31	13 16	12 57
2	15 53	15 50	15 47	15 43	15 39	15 35	15 30	15 25	15 19	15 12	15 05	14 56	14 46	14 34
3	16 52	16 51	16 48	16 46	16 44	16 41	16 38	16 35	16 32	16 28	16 24	16 19	16 13	16 07
4	17 51	17 50	17 49	17 49	17 48	17 47	17 46	17 45	17 44	17 43	17 41	17 40	17 38	17 36
5	18 49	18 49	18 50	18 51	18 51	18 52	18 53	18 54	18 55	18 56	18 58	18 59	19 01	19 03
6	19 46	19 48	19 50	19 52	19 55	19 57	20 00	20 03	20 06	20 10	20 14	20 19	20 25	20 31
7	20 45	20 48	20 51	20 55	20 59	21 03	21 07	21 13	21 18	21 25	21 32	21 40	21 50	22 01
8	21 43	21 48	21 52	21 57	22 03	22 09	22 15	22 23	22 31	22 40	22 50	23 03	23 17	23 35
9	22 43	22 48	22 54	23 00	23 07	23 15	23 23	23 32	23 43	23 55	...	...	...	...
10	23 42	23 48	23 55	...	...	...	...	...	...	...	0 09	0 26	0 47	1 13
11	...	...	...	0 03	0 11	0 19	0 29	0 40	0 53	1 08	1 25	1 47	2 15	2 56

■ indicates Moon continuously below horizon.

... indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	11 04	10 43	10 27	10 14	10 03	9 53	9 37	9 23	9 09	8 56	8 42	8 26	8 16	8 06
10	12 14	11 49	11 30	11 14	11 00	10 49	10 29	10 12	9 56	9 40	9 24	9 04	8 53	8 40
11	13 21	12 52	12 30	12 12	11 58	11 45	11 23	11 04	10 46	10 28	10 10	9 48	9 35	9 21
12	14 21	13 51	13 27	13 09	12 53	12 40	12 17	11 57	11 38	11 20	11 00	10 37	10 24	10 09
13	15 11	14 41	14 19	14 01	13 46	13 33	13 10	12 51	12 33	12 15	11 55	11 33	11 19	11 04
14	15 50	15 24	15 04	14 48	14 35	14 23	14 02	13 45	13 28	13 11	12 54	12 33	12 21	12 07
15	16 20	15 59	15 43	15 30	15 19	15 09	14 52	14 37	14 23	14 09	13 54	13 37	13 27	13 16
16	16 43	16 29	16 17	16 08	15 59	15 52	15 40	15 29	15 18	15 08	14 57	14 44	14 36	14 28
17	17 03	16 54	16 48	16 42	16 37	16 33	16 25	16 19	16 12	16 06	15 59	15 52	15 47	15 42
18	17 20	17 18	17 16	17 14	17 13	17 12	17 10	17 08	17 06	17 04	17 03	17 01	16 59	16 58
19	17 37	17 41	17 44	17 46	17 49	17 51	17 54	17 57	18 00	18 03	18 06	18 10	18 12	18 15
20	17 56	18 05	18 13	18 20	18 26	18 31	18 40	18 48	18 55	19 03	19 11	19 20	19 26	19 32
21	18 17	18 33	18 46	18 56	19 06	19 14	19 28	19 40	19 52	20 03	20 16	20 31	20 39	20 49
22	18 44	19 06	19 23	19 38	19 50	20 00	20 19	20 35	20 50	21 05	21 21	21 40	21 51	22 04
23	19 20	19 47	20 08	20 24	20 39	20 51	21 12	21 31	21 48	22 06	22 25	22 46	22 59	23 14
24	20 07	20 36	20 59	21 17	21 32	21 46	22 08	22 28	22 47	23 05	23 25	23 48	.. ..	.. ..
25	21 05	21 34	21 57	22 15	22 30	22 43	23 05	23 25	23 43	.. ..	.. ..	.. ..	0 01	0 17
26	22 12	22 39	22 59	23 16	23 29	23 41	.. ..	.. ..	.. ..	0 01	0 20	0 43	0 56	1 11
27	23 24	23 46	.. ..	.. ..	.. ..	.. ..	0 02	0 20	0 36	0 53	1 11	1 31	1 43	1 56
28	.. ..	.. ..	0 03	0 17	0 29	0 39	0 57	1 12	1 26	1 41	1 56	2 13	2 23	2 34
29	0 38	0 54	1 07	1 18	1 28	1 36	1 50	2 02	2 13	2 24	2 36	2 50	2 58	3 07
30	1 50	2 01	2 11	2 18	2 25	2 30	2 40	2 49	2 57	3 05	3 14	3 23	3 29	3 35
31	3 01	3 07	3 13	3 17	3 21	3 24	3 29	3 34	3 39	3 44	3 48	3 54	3 57	4 01
Apr. 1	4 11	4 12	4 14	4 15	4 15	4 16	4 17	4 19	4 20	4 21	4 22	4 23	4 24	4 25
2	5 21	5 17	5 14	5 12	5 10	5 08	5 05	5 03	5 00	4 58	4 55	4 52	4 51	4 49

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	19 29	19 50	20 07	20 21	20 33	20 43	21 01	21 17	21 32	21 46	22 02	22 20	22 31	22 43
10	19 56	20 22	20 42	20 58	21 12	21 24	21 45	22 03	22 20	22 37	22 55	23 16	23 28	23 42
11	20 32	21 02	21 24	21 42	21 58	22 11	22 33	22 53	23 11	23 29	23 49	.. ..	.. ..	.. ..
12	21 22	21 52	22 15	22 34	22 50	23 03	23 26	23 46	.. ..	.. ..	.. ..	0 11	0 24	0 40
13	22 25	22 54	23 16	23 33	23 48	.. ..	.. ..	.. ..	0 04	0 23	0 43	1 05	1 19	1 34
14	23 40	.. ..	.. ..	.. ..	.. ..	0 01	0 23	0 42	0 59	1 17	1 35	1 57	2 09	2 24
15	.. ..	0 05	0 24	0 39	0 52	1 03	1 22	1 39	1 54	2 10	2 26	2 45	2 56	3 08
16	1 04	1 23	1 38	1 50	2 00	2 09	2 24	2 37	2 50	3 02	3 15	3 30	3 38	3 48
17	2 33	2 45	2 55	3 03	3 10	3 16	3 26	3 36	3 44	3 52	4 01	4 11	4 17	4 23
18	4 04	4 10	4 14	4 18	4 22	4 24	4 29	4 34	4 38	4 42	4 46	4 51	4 53	4 56
19	5 36	5 36	5 35	5 34	5 34	5 34	5 33	5 32	5 32	5 31	5 30	5 29	5 29	5 28
20	7 10	7 02	6 56	6 51	6 47	6 43	6 37	6 31	6 26	6 21	6 15	6 09	6 05	6 01
21	8 43	8 29	8 18	8 08	8 01	7 54	7 42	7 31	7 22	7 12	7 02	6 50	6 43	6 36
22	10 14	9 54	9 38	9 25	9 13	9 04	8 47	8 33	8 19	8 06	7 51	7 35	7 25	7 14
23	11 40	11 14	10 54	10 37	10 24	10 12	9 52	9 34	9 18	9 01	8 44	8 23	8 12	7 58
24	12 54	12 25	12 02	11 44	11 29	11 16	10 54	10 34	10 16	9 58	9 39	9 16	9 03	8 48
25	13 54	13 24	13 01	12 43	12 28	12 15	11 52	11 32	11 14	10 55	10 36	10 13	9 59	9 44
26	14 38	14 11	13 50	13 33	13 19	13 06	12 45	12 26	12 09	11 51	11 33	11 11	10 58	10 43
27	15 10	14 48	14 30	14 15	14 02	13 52	13 33	13 16	13 01	12 45	12 29	12 09	11 58	11 45
28	15 34	15 16	15 02	14 50	14 40	14 31	14 16	14 02	13 49	13 36	13 22	13 07	12 57	12 47
29	15 53	15 40	15 29	15 20	15 13	15 06	14 54	14 44	14 34	14 25	14 14	14 02	13 55	13 47
30	16 08	16 00	15 53	15 47	15 42	15 38	15 30	15 24	15 17	15 11	15 04	14 56	14 52	14 47
31	16 21	16 18	16 15	16 12	16 10	16 08	16 05	16 02	15 59	15 56	15 53	15 49	15 47	15 45
Apr. 1	16 34	16 35	16 35	16 36	16 37	16 37	16 38	16 39	16 39	16 40	16 41	16 41	16 42	16 42
2	16 46	16 52	16 56	17 00	17 03	17 06	17 11	17 16	17 20	17 24	17 29	17 34	17 37	17 40

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

39

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40	+42	+44	+46	+48	+50	+52	+54	+56	+58	+60	+62	+64	+66
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	8 06	8 01	7 56	7 50	7 45	7 38	7 31	7 23	7 15	7 05	6 54	6 41	6 25	6 07
10	8 40	8 35	8 28	8 22	8 15	8 07	7 58	7 48	7 37	7 25	7 10	6 53	6 32	6 04
11	9 21	9 14	9 07	9 00	8 52	8 42	8 32	8 21	8 08	7 53	7 35	7 13	6 45	6 04
12	10 09	10 02	9 54	9 46	9 37	9 28	9 17	9 04	8 50	8 34	8 14	7 49	7 14	6 12
13	11 04	10 57	10 50	10 42	10 33	10 24	10 13	10 01	9 47	9 30	9 11	8 46	8 12	7 11
14	12 07	12 01	11 54	11 47	11 39	11 30	11 21	11 10	10 57	10 43	10 26	10 05	9 38	8 59
15	13 16	13 10	13 05	12 59	12 52	12 45	12 37	12 29	12 19	12 07	11 54	11 39	11 20	10 56
16	14 28	14 24	14 20	14 16	14 11	14 06	14 00	13 54	13 47	13 39	13 30	13 20	13 08	12 53
17	15 42	15 40	15 38	15 35	15 33	15 30	15 26	15 23	15 19	15 14	15 09	15 04	14 57	14 49
18	16 58	16 58	16 57	16 56	16 56	16 55	16 54	16 53	16 52	16 51	16 50	16 48	16 47	16 45
19	18 15	18 16	18 17	18 18	18 20	18 21	18 23	18 25	18 27	18 29	18 31	18 34	18 37	18 41
20	19 32	19 35	19 38	19 41	19 44	19 48	19 52	19 57	20 02	20 07	20 14	20 21	20 29	20 40
21	20 49	20 53	20 58	21 03	21 08	21 14	21 21	21 28	21 36	21 45	21 56	22 08	22 23	22 41
22	22 04	22 09	22 15	22 22	22 29	22 37	22 46	22 56	23 07	23 20	23 35	23 53	...	...
23	23 14	23 20	23 27	23 35	23 44	23 53	...	...	...	...	...	...	0 16	0 46
24	...	...	...	...	...	...	0 03	0 15	0 29	0 45	1 03	1 27	1 59	2 50
25	0 17	0 24	0 31	0 39	0 48	0 58	1 09	1 22	1 36	1 53	2 14	2 40	3 16	4 32
26	1 11	1 18	1 25	1 33	1 41	1 51	2 02	2 14	2 27	2 43	3 02	3 26	3 58	4 50
27	1 56	2 02	2 09	2 16	2 24	2 32	2 42	2 52	3 04	3 17	3 33	3 53	4 17	4 49
28	2 34	2 40	2 45	2 51	2 57	3 04	3 12	3 20	3 30	3 41	3 53	4 08	4 25	4 47
29	3 07	3 11	3 15	3 20	3 25	3 30	3 36	3 42	3 49	3 57	4 06	4 17	4 29	4 44
30	3 35	3 38	3 41	3 44	3 47	3 51	3 55	4 00	4 05	4 10	4 16	4 23	4 31	4 40
31	4 01	4 02	4 04	4 06	4 08	4 10	4 12	4 15	4 17	4 20	4 24	4 28	4 32	4 37
Apr. 1	4 25	4 25	4 26	4 26	4 27	4 27	4 28	4 28	4 29	4 30	4 31	4 31	4 32	4 34
2	4 49	4 48	4 47	4 46	4 45	4 44	4 43	4 42	4 40	4 39	4 37	4 35	4 33	4 30

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	22 43	22 48	22 54	23 00	23 07	23 15	23 23	23 32	23 43	23 55	...	...	...	...
10	23 42	23 48	23 55	...	...	...	...	...	...	...	0 09	0 26	0 47	1 13
11	...	...	...	0 03	0 11	0 19	0 29	0 40	0 53	1 08	1 25	1 47	2 15	2 56
12	0 40	0 47	0 54	1 02	1 11	1 20	1 31	1 43	1 57	2 14	2 34	2 59	3 33	4 35
13	1 34	1 41	1 48	1 56	2 05	2 15	2 26	2 38	2 52	3 09	3 29	3 54	4 28	5 29
14	2 24	2 30	2 37	2 45	2 53	3 02	3 12	3 23	3 36	3 50	4 08	4 29	4 56	5 35
15	3 08	3 14	3 20	3 26	3 33	3 40	3 49	3 58	4 08	4 20	4 34	4 50	5 10	5 35
16	3 48	3 52	3 57	4 01	4 07	4 12	4 19	4 26	4 33	4 42	4 52	5 03	5 16	5 32
17	4 23	4 26	4 29	4 32	4 36	4 40	4 44	4 48	4 53	4 59	5 05	5 12	5 20	5 29
18	4 56	4 58	4 59	5 01	5 02	5 04	5 06	5 08	5 10	5 13	5 15	5 18	5 22	5 26
19	5 28	5 28	5 28	5 28	5 27	5 27	5 27	5 26	5 26	5 25	5 25	5 24	5 23	5 23
20	6 01	5 59	5 57	5 55	5 53	5 50	5 48	5 45	5 42	5 38	5 34	5 30	5 25	5 19
21	6 36	6 32	6 29	6 25	6 21	6 16	6 11	6 06	6 00	5 53	5 46	5 37	5 28	5 16
22	7 14	7 10	7 04	6 59	6 53	6 46	6 39	6 31	6 22	6 12	6 01	5 48	5 32	5 13
23	7 58	7 52	7 46	7 39	7 31	7 23	7 14	7 04	6 52	6 39	6 23	6 04	5 41	5 10
24	8 48	8 41	8 34	8 26	8 18	8 08	7 57	7 45	7 32	7 16	6 57	6 33	6 01	5 09
25	9 44	9 37	9 29	9 21	9 12	9 02	8 51	8 39	8 24	8 07	7 47	7 21	6 44	5 28
26	10 43	10 37	10 30	10 22	10 13	10 04	9 54	9 42	9 28	9 13	8 54	8 30	7 58	7 07
27	11 45	11 39	11 33	11 26	11 19	11 11	11 02	10 52	10 40	10 27	10 11	9 53	9 29	8 57
28	12 47	12 42	12 37	12 31	12 25	12 19	12 12	12 04	11 55	11 44	11 33	11 19	11 02	10 41
29	13 47	13 44	13 40	13 36	13 31	13 27	13 21	13 16	13 09	13 02	12 53	12 44	12 33	12 19
30	14 47	14 44	14 42	14 39	14 36	14 33	14 30	14 26	14 22	14 18	14 12	14 06	14 00	13 52
31	15 45	15 44	15 43	15 42	15 40	15 39	15 37	15 36	15 34	15 32	15 30	15 27	15 24	15 20
Apr. 1	16 42	16 43	16 43	16 43	16 43	16 44	16 44	16 44	16 45	16 45	16 46	16 46	16 47	16 48
2	17 40	17 41	17 43	17 45	17 47	17 49	17 51	17 53	17 56	17 59	18 02	18 06	18 10	18 15

... indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.		-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr.	1	4 11	4 12	4 14	4 15	4 15	4 16	4 17	4 19	4 20	4 21	4 22	4 23	4 24	4 25
	2	5 21	5 17	5 14	5 12	5 10	5 08	5 05	5 03	5 00	4 58	4 55	4 52	4 51	4 49
	3	6 31	6 22	6 15	6 10	6 05	6 01	5 54	5 47	5 41	5 35	5 29	5 22	5 18	5 13
	4	7 41	7 28	7 17	7 08	7 01	6 54	6 43	6 33	6 23	6 14	6 04	5 53	5 47	5 40
	5	8 53	8 34	8 20	8 08	7 57	7 48	7 33	7 20	7 08	6 55	6 42	6 27	6 19	6 09
	6	10 04	9 40	9 22	9 07	8 55	8 44	8 25	8 09	7 54	7 39	7 23	7 05	6 54	6 42
	7	11 12	10 44	10 23	10 06	9 52	9 39	9 18	9 00	8 43	8 26	8 08	7 47	7 35	7 21
	8	12 13	11 43	11 21	11 02	10 47	10 34	10 12	9 52	9 34	9 16	8 56	8 34	8 21	8 06
	9	13 05	12 36	12 13	11 55	11 40	11 27	11 04	10 45	10 27	10 09	9 49	9 27	9 14	8 58
	10	13 47	13 20	13 00	12 43	12 29	12 17	11 56	11 37	11 20	11 03	10 45	10 24	10 11	9 57
	11	14 19	13 57	13 40	13 25	13 13	13 03	12 45	12 29	12 14	11 59	11 43	11 25	11 14	11 02
	12	14 44	14 27	14 14	14 03	13 54	13 46	13 31	13 19	13 07	12 55	12 42	12 28	12 19	12 10
	13	15 04	14 54	14 45	14 37	14 31	14 26	14 16	14 07	13 59	13 51	13 43	13 33	13 27	13 20
	14	15 22	15 17	15 13	15 10	15 07	15 04	14 59	14 55	14 51	14 47	14 43	14 39	14 36	14 33
	15	15 39	15 40	15 41	15 41	15 41	15 42	15 42	15 43	15 44	15 44	15 45	15 46	15 46	15 47
	16	15 57	16 03	16 09	16 13	16 17	16 21	16 27	16 32	16 37	16 42	16 48	16 54	16 58	17 02
	17	16 17	16 30	16 40	16 48	16 56	17 02	17 13	17 23	17 33	17 42	17 53	18 04	18 11	18 19
	18	16 42	17 00	17 15	17 27	17 38	17 47	18 03	18 17	18 31	18 44	18 59	19 15	19 25	19 36
	19	17 14	17 38	17 57	18 12	18 26	18 37	18 57	19 14	19 31	19 47	20 04	20 25	20 37	20 50
	20	17 56	18 25	18 47	19 04	19 19	19 32	19 54	20 13	20 31	20 49	21 08	21 31	21 44	21 59
	21	18 52	19 21	19 44	20 02	20 17	20 30	20 53	21 12	21 30	21 49	22 08	22 31	22 44	22 59
	22	19 58	20 26	20 47	21 04	21 18	21 30	21 51	22 10	22 27	22 44	23 02	23 23	23 36	23 50
	23	21 11	21 34	21 52	22 07	22 19	22 30	22 49	23 05	23 20	23 35	23 51	.. ..	.. ..	.. ..
	24	22 25	22 43	22 58	23 09	23 20	23 28	23 43	23 56	.. ..	.. ..	.. ..	0 09	0 20	0 32
	25	23 39	23 52	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 09	0 21	0 34	0 49	0 57	1 07

MOONSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr.	1	16 34	16 35	16 35	16 36	16 37	16 37	16 38	16 39	16 39	16 40	16 41	16 41	16 42	16 42
	2	16 46	16 52	16 56	17 00	17 03	17 06	17 11	17 16	17 20	17 24	17 29	17 34	17 37	17 40
	3	17 00	17 10	17 18	17 25	17 31	17 37	17 46	17 54	18 01	18 09	18 17	18 26	18 32	18 38
	4	17 16	17 31	17 43	17 53	18 01	18 09	18 22	18 34	18 44	18 55	19 07	19 20	19 28	19 37
	5	17 35	17 55	18 11	18 24	18 35	18 45	19 01	19 16	19 30	19 43	19 58	20 15	20 25	20 36
	6	18 01	18 25	18 44	19 00	19 13	19 24	19 44	20 01	20 17	20 33	20 51	21 10	21 22	21 35
	7	18 34	19 02	19 24	19 41	19 56	20 09	20 31	20 49	21 07	21 25	21 44	22 06	22 18	22 33
	8	19 19	19 49	20 12	20 30	20 45	20 59	21 21	21 41	21 59	22 17	22 37	23 00	23 13	23 28
	9	20 16	20 45	21 08	21 25	21 40	21 53	22 16	22 35	22 52	23 10	23 29	23 51	.. ..	.. ..
	10	21 25	21 51	22 11	22 27	22 41	22 52	23 13	23 30	23 46	.. ..	.. ..	.. ..	0 04	0 18
	11	22 43	23 04	23 20	23 34	23 45	23 55	.. ..	.. ..	.. ..	0 02	0 19	0 39	0 50	1 03
	12	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 11	0 26	0 39	0 53	1 07	1 23	1 33	1 43
	13	0 07	0 22	0 33	0 43	0 51	0 59	1 11	1 22	1 32	1 42	1 52	2 04	2 11	2 19
	14	1 33	1 42	1 49	1 55	2 00	2 04	2 11	2 18	2 24	2 30	2 36	2 43	2 47	2 52
	15	3 02	3 04	3 06	3 08	3 09	3 10	3 12	3 14	3 16	3 18	3 19	3 21	3 22	3 23
	16	4 32	4 28	4 25	4 23	4 20	4 18	4 15	4 12	4 09	4 06	4 03	3 59	3 57	3 55
	17	6 04	5 54	5 46	5 39	5 33	5 28	5 19	5 11	5 03	4 56	4 48	4 39	4 34	4 28
	18	7 37	7 20	7 07	6 56	6 46	6 38	6 24	6 12	6 00	5 49	5 36	5 22	5 14	5 05
	19	9 08	8 44	8 26	8 12	7 59	7 48	7 30	7 14	6 59	6 44	6 28	6 10	5 59	5 47
	20	10 30	10 02	9 41	9 24	9 09	8 57	8 35	8 17	7 59	7 42	7 24	7 02	6 50	6 36
	21	11 39	11 09	10 47	10 28	10 13	10 00	9 37	9 18	9 00	8 41	8 22	7 59	7 46	7 30
	22	12 31	12 03	11 41	11 24	11 09	10 57	10 35	10 16	9 58	9 40	9 21	8 59	8 46	8 31
	23	13 09	12 45	12 26	12 10	11 57	11 46	11 26	11 09	10 53	10 37	10 19	9 59	9 47	9 34
	24	13 37	13 17	13 02	12 49	12 38	12 28	12 12	11 57	11 44	11 30	11 15	10 58	10 48	10 37
	25	13 57	13 43	13 31	13 21	13 13	13 06	12 53	12 42	12 31	12 20	12 09	11 56	11 48	11 39

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

41

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
Apr. 1	h m 4 25	h m 4 25	h m 4 26	h m 4 26	h m 4 27	h m 4 27	h m 4 28	h m 4 28	h m 4 29	h m 4 30	h m 4 31	h m 4 31	h m 4 32	h m 4 34
2	4 49	4 48	4 47	4 46	4 45	4 44	4 43	4 42	4 40	4 39	4 37	4 35	4 33	4 30
3	5 13	5 11	5 09	5 07	5 05	5 02	4 59	4 56	4 52	4 49	4 44	4 39	4 34	4 27
4	5 40	5 37	5 33	5 29	5 26	5 21	5 17	5 12	5 06	5 00	4 53	4 45	4 35	4 24
5	6 09	6 05	6 00	5 55	5 50	5 44	5 37	5 30	5 22	5 14	5 04	4 52	4 38	4 22
6	6 42	6 37	6 31	6 25	6 18	6 11	6 03	5 54	5 44	5 32	5 19	5 03	4 44	4 20
7	7 21	7 15	7 08	7 01	6 53	6 44	6 35	6 24	6 12	5 58	5 41	5 21	4 56	4 21
8	8 06	7 59	7 52	7 44	7 36	7 26	7 16	7 04	6 50	6 34	6 15	5 51	5 20	4 29
9	8 58	8 52	8 44	8 36	8 27	8 18	8 07	7 55	7 41	7 25	7 05	6 40	6 07	5 09
10	9 57	9 51	9 44	9 36	9 28	9 19	9 09	8 58	8 45	8 30	8 12	7 51	7 22	6 39
11	11 02	10 56	10 50	10 44	10 37	10 29	10 21	10 11	10 00	9 48	9 34	9 17	8 55	8 28
12	12 10	12 05	12 01	11 56	11 50	11 45	11 38	11 31	11 23	11 14	11 03	10 51	10 37	10 19
13	13 20	13 18	13 14	13 11	13 08	13 04	12 59	12 55	12 49	12 44	12 37	12 29	12 20	12 10
14	14 33	14 31	14 30	14 28	14 27	14 25	14 23	14 21	14 18	14 16	14 13	14 09	14 05	14 01
15	15 47	15 47	15 47	15 48	15 48	15 48	15 49	15 49	15 50	15 50	15 51	15 51	15 52	15 53
16	17 02	17 04	17 06	17 08	17 11	17 13	17 16	17 19	17 23	17 26	17 31	17 35	17 41	17 48
17	18 19	18 23	18 26	18 30	18 35	18 40	18 45	18 51	18 57	19 04	19 13	19 22	19 33	19 47
18	19 36	19 41	19 46	19 52	19 58	20 05	20 13	20 21	20 31	20 42	20 54	21 09	21 27	21 50
19	20 50	20 57	21 03	21 10	21 18	21 27	21 36	21 47	22 00	22 14	22 31	22 51	23 18	23 56
20	21 59	22 06	22 13	22 21	22 30	22 40	22 50	23 03	23 17	23 33	23 53	.. ..	.. ..	.. ..
21	22 59	23 06	23 13	23 21	23 30	23 40	23 51	.. ..	.. ..	.. ..	.. ..	0 18	0 52	1 52
22	23 50	23 56	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 17	0 33	0 53	1 18	1 51	2 49
23	.. ..	.. ..	0 03	0 10	0 18	0 27	0 37	0 48	1 00	1 15	1 32	1 53	2 19	2 56
24	0 32	0 37	0 43	0 49	0 56	1 04	1 12	1 21	1 31	1 43	1 56	2 12	2 32	2 56
25	1 07	1 11	1 16	1 21	1 26	1 32	1 39	1 46	1 54	2 02	2 12	2 24	2 38	2 54

MOONSET

Apr. 1	h m 16 42	h m 16 43	h m 16 43	h m 16 43	h m 16 43	h m 16 44	h m 16 44	h m 16 44	h m 16 45	h m 16 45	h m 16 46	h m 16 46	h m 16 47	h m 16 48
2	17 40	17 41	17 43	17 45	17 47	17 49	17 51	17 53	17 56	17 59	18 02	18 06	18 10	18 15
3	18 38	18 41	18 44	18 47	18 50	18 54	18 58	19 02	19 07	19 13	19 19	19 26	19 34	19 44
4	19 37	19 41	19 45	19 49	19 54	20 00	20 06	20 12	20 19	20 28	20 37	20 48	21 00	21 16
5	20 36	20 41	20 47	20 52	20 59	21 06	21 14	21 22	21 32	21 43	21 55	22 10	22 29	22 52
6	21 35	21 41	21 48	21 55	22 02	22 11	22 20	22 31	22 42	22 56	23 12	23 32	23 57	.. ..
7	22 33	22 40	22 47	22 55	23 03	23 13	23 23	23 35	23 48	.. ..	.. ..	.. ..	.. ..	0 31
8	23 28	23 35	23 42	23 50	23 59	.. ..	.. ..	.. ..	.. ..	0 04	0 23	0 46	1 18	2 08
9	.. ..	.. ..	.. ..	.. ..	.. ..	0 09	0 19	0 32	0 46	1 02	1 22	1 46	2 20	3 18
10	0 18	0 25	0 32	0 40	0 48	0 57	1 07	1 19	1 32	1 47	2 05	2 27	2 56	3 39
11	1 03	1 09	1 15	1 22	1 29	1 37	1 46	1 56	2 07	2 20	2 35	2 53	3 14	3 43
12	1 43	1 48	1 53	1 58	2 04	2 11	2 18	2 26	2 34	2 44	2 55	3 08	3 24	3 42
13	2 19	2 22	2 26	2 30	2 34	2 39	2 44	2 49	2 55	3 02	3 10	3 18	3 29	3 40
14	2 52	2 54	2 56	2 58	3 01	3 04	3 06	3 10	3 13	3 17	3 21	3 26	3 31	3 38
15	3 23	3 24	3 25	3 25	3 26	3 26	3 27	3 28	3 29	3 30	3 31	3 32	3 34	3 35
16	3 55	3 54	3 53	3 52	3 51	3 49	3 48	3 46	3 45	3 43	3 41	3 38	3 35	3 32
17	4 28	4 26	4 23	4 20	4 17	4 14	4 10	4 06	4 02	3 57	3 51	3 45	3 38	3 30
18	5 05	5 01	4 57	4 52	4 47	4 42	4 36	4 29	4 22	4 14	4 05	3 54	3 42	3 27
19	5 47	5 42	5 36	5 30	5 23	5 16	5 08	4 58	4 48	4 37	4 24	4 08	3 49	3 25
20	6 36	6 29	6 22	6 15	6 07	5 58	5 48	5 37	5 24	5 09	4 52	4 31	4 04	3 26
21	7 30	7 24	7 16	7 08	6 59	6 50	6 39	6 26	6 12	5 56	5 36	5 11	4 37	3 36
22	8 31	8 24	8 17	8 09	8 00	7 50	7 40	7 28	7 14	6 58	6 38	6 14	5 40	4 43
23	9 34	9 27	9 21	9 14	9 06	8 57	8 48	8 37	8 25	8 11	7 54	7 34	7 08	6 32
24	10 37	10 32	10 26	10 20	10 14	10 07	9 59	9 51	9 41	9 30	9 17	9 01	8 43	8 19
25	11 39	11 35	11 31	11 26	11 22	11 16	11 10	11 04	10 57	10 48	10 39	10 28	10 16	10 00

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	22 25	22 43	22 58	23 09	23 20	23 28	23 43	23 56	...	...	...	0 09	0 20	0 32
25	23 39	23 52	...	...	...	...	...	...	0 09	0 21	0 34	0 49	0 57	1 07
26	...	...	0 02	0 11	0 18	0 24	0 35	0 45	0 54	1 03	1 13	1 24	1 30	1 37
27	0 50	0 58	1 05	1 10	1 15	1 19	1 25	1 31	1 37	1 43	1 49	1 56	1 59	2 04
28	2 01	2 04	2 06	2 08	2 10	2 11	2 14	2 16	2 18	2 21	2 23	2 25	2 27	2 29
29	3 10	3 08	3 07	3 05	3 04	3 03	3 02	3 00	2 59	2 58	2 56	2 55	2 54	2 53
30	4 20	4 13	4 08	4 03	3 59	3 56	3 50	3 44	3 40	3 35	3 30	3 24	3 21	3 17
May 1	5 30	5 18	5 09	5 01	4 54	4 49	4 38	4 30	4 21	4 13	4 05	3 55	3 49	3 43
2	6 42	6 25	6 11	6 00	5 51	5 43	5 29	5 16	5 05	4 54	4 42	4 28	4 20	4 11
3	7 53	7 31	7 14	7 00	6 48	6 38	6 20	6 05	5 51	5 37	5 22	5 05	4 55	4 44
4	9 02	8 36	8 16	8 00	7 46	7 34	7 14	6 56	6 40	6 23	6 06	5 46	5 34	5 21
5	10 07	9 37	9 15	8 57	8 42	8 29	8 07	7 48	7 31	7 13	6 54	6 32	6 19	6 05
6	11 02	10 32	10 10	9 52	9 36	9 23	9 01	8 41	8 23	8 05	7 46	7 23	7 10	6 55
7	11 46	11 19	10 58	10 41	10 26	10 14	9 53	9 34	9 17	8 59	8 41	8 19	8 07	7 52
8	12 21	11 57	11 39	11 24	11 12	11 01	10 42	10 25	10 10	9 54	9 38	9 19	9 07	8 54
9	12 47	12 29	12 15	12 03	11 53	11 44	11 28	11 15	11 02	10 49	10 36	10 20	10 11	10 00
10	13 09	12 56	12 46	12 37	12 30	12 24	12 12	12 03	11 53	11 44	11 34	11 23	11 16	11 09
11	13 27	13 20	13 14	13 09	13 05	13 01	12 55	12 49	12 44	12 38	12 33	12 26	12 22	12 18
12	13 43	13 42	13 41	13 39	13 39	13 38	13 36	13 35	13 34	13 33	13 32	13 30	13 29	13 29
13	14 00	14 04	14 07	14 10	14 13	14 15	14 18	14 22	14 25	14 28	14 32	14 36	14 38	14 41
14	14 18	14 28	14 36	14 43	14 48	14 54	15 02	15 10	15 18	15 25	15 34	15 43	15 48	15 54
15	14 40	14 56	15 08	15 19	15 28	15 36	15 50	16 02	16 13	16 25	16 37	16 52	17 00	17 10
16	15 08	15 30	15 46	16 00	16 12	16 23	16 41	16 57	17 11	17 26	17 43	18 01	18 12	18 24
17	15 45	16 12	16 32	16 49	17 03	17 15	17 36	17 55	18 12	18 29	18 48	19 09	19 22	19 36
18	16 35	17 04	17 26	17 44	17 59	18 13	18 35	18 54	19 13	19 31	19 50	20 13	20 26	20 42

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	13 37	13 17	13 02	12 49	12 38	12 28	12 12	11 57	11 44	11 30	11 15	10 58	10 48	10 37
25	13 57	13 43	13 31	13 21	13 13	13 06	12 53	12 42	12 31	12 20	12 09	11 56	11 48	11 39
26	14 14	14 04	13 56	13 50	13 44	13 39	13 30	13 22	13 15	13 08	13 00	12 51	12 45	12 39
27	14 28	14 23	14 19	14 15	14 12	14 10	14 05	14 01	13 57	13 53	13 49	13 44	13 41	13 38
28	14 41	14 40	14 40	14 40	14 39	14 39	14 39	14 38	14 38	14 38	14 37	14 37	14 36	14 36
29	14 54	14 58	15 01	15 04	15 06	15 08	15 12	15 15	15 18	15 22	15 25	15 29	15 31	15 33
30	15 07	15 16	15 23	15 29	15 34	15 38	15 46	15 53	16 00	16 06	16 13	16 21	16 26	16 31
May 1	15 22	15 36	15 47	15 56	16 03	16 10	16 22	16 32	16 42	16 52	17 03	17 15	17 22	17 30
2	15 41	15 59	16 14	16 26	16 36	16 45	17 01	17 14	17 27	17 40	17 54	18 09	18 18	18 29
3	16 05	16 28	16 46	17 00	17 13	17 24	17 42	17 59	18 14	18 30	18 46	19 05	19 16	19 29
4	16 36	17 03	17 24	17 41	17 55	18 07	18 28	18 47	19 04	19 21	19 39	20 01	20 13	20 28
5	17 18	17 47	18 10	18 28	18 43	18 56	19 18	19 38	19 56	20 14	20 33	20 56	21 09	21 24
6	18 12	18 41	19 03	19 21	19 36	19 49	20 12	20 31	20 49	21 07	21 26	21 48	22 01	22 15
7	19 17	19 44	20 05	20 21	20 35	20 47	21 08	21 26	21 42	21 59	22 16	22 37	22 48	23 02
8	20 32	20 54	21 11	21 26	21 37	21 48	22 05	22 21	22 35	22 49	23 04	23 21	23 31	23 43
9	21 52	22 09	22 22	22 33	22 42	22 50	23 04	23 16	23 27	23 38	23 49	...	...	...
10	23 15	23 26	23 34	23 42	23 48	23 53	...	...	...	...	...	0 03	0 10	0 19
11	...	...	...	...	...	...	0 02	0 10	0 17	0 25	0 32	0 41	0 46	0 52
12	0 40	0 45	0 48	0 51	0 54	0 57	1 01	1 04	1 07	1 11	1 14	1 18	1 20	1 23
13	2 06	2 05	2 04	2 03	2 02	2 01	2 00	1 59	1 58	1 57	1 56	1 55	1 54	1 53
14	3 34	3 27	3 21	3 16	3 11	3 07	3 01	2 55	2 50	2 44	2 39	2 32	2 28	2 24
15	5 04	4 50	4 39	4 30	4 22	4 15	4 04	3 53	3 44	3 34	3 24	3 13	3 06	2 58
16	6 34	6 14	5 58	5 45	5 34	5 25	5 08	4 54	4 41	4 27	4 13	3 57	3 48	3 37
17	8 00	7 35	7 15	6 59	6 45	6 34	6 14	5 56	5 40	5 24	5 06	4 47	4 35	4 22
18	9 17	8 48	8 26	8 08	7 53	7 40	7 18	6 59	6 41	6 23	6 04	5 42	5 29	5 14

... indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

43

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	0 32	0 37	0 43	0 49	0 56	1 04	1 12	1 21	1 31	1 43	1 56	2 12	2 32	2 56
25	1 07	1 11	1 16	1 21	1 26	1 32	1 39	1 46	1 54	2 02	2 12	2 24	2 38	2 54
26	1 37	1 40	1 44	1 47	1 51	1 55	2 00	2 05	2 10	2 17	2 24	2 32	2 41	2 51
27	2 04	2 06	2 08	2 10	2 13	2 15	2 18	2 21	2 24	2 28	2 32	2 37	2 42	2 49
28	2 29	2 29	2 30	2 31	2 32	2 33	2 34	2 35	2 37	2 38	2 40	2 41	2 43	2 46
29	2 53	2 52	2 52	2 51	2 51	2 50	2 50	2 49	2 48	2 47	2 46	2 45	2 44	2 43
30	3 17	3 15	3 14	3 12	3 10	3 08	3 05	3 03	3 00	2 57	2 53	2 50	2 45	2 40
May 1	3 43	3 40	3 37	3 34	3 30	3 27	3 23	3 18	3 13	3 08	3 02	2 55	2 47	2 37
2	4 11	4 07	4 03	3 59	3 54	3 48	3 43	3 36	3 29	3 21	3 12	3 02	2 50	2 35
3	4 44	4 39	4 33	4 27	4 21	4 14	4 07	3 58	3 49	3 38	3 26	3 12	2 55	2 34
4	5 21	5 15	5 09	5 02	4 54	4 46	4 37	4 27	4 15	4 02	3 47	3 28	3 05	2 35
5	6 05	5 58	5 51	5 43	5 35	5 26	5 15	5 04	4 51	4 35	4 17	3 55	3 25	2 41
6	6 55	6 48	6 41	6 33	6 24	6 15	6 04	5 52	5 38	5 22	5 03	4 38	4 05	3 10
7	7 52	7 46	7 39	7 31	7 23	7 13	7 03	6 52	6 39	6 23	6 05	5 42	5 13	4 27
8	8 54	8 49	8 42	8 36	8 28	8 20	8 12	8 02	7 50	7 37	7 22	7 04	6 41	6 10
9	10 00	9 56	9 51	9 45	9 39	9 33	9 26	9 18	9 09	8 59	8 48	8 34	8 18	7 58
10	11 09	11 05	11 02	10 58	10 54	10 49	10 44	10 39	10 33	10 26	10 18	10 09	9 59	9 46
11	12 18	12 16	12 14	12 12	12 10	12 07	12 04	12 01	11 58	11 54	11 50	11 45	11 39	11 33
12	13 29	13 28	13 28	13 27	13 27	13 26	13 26	13 25	13 25	13 24	13 23	13 22	13 21	13 20
13	14 41	14 42	14 43	14 44	14 46	14 48	14 49	14 51	14 53	14 56	14 58	15 01	15 05	15 09
14	15 54	15 57	16 00	16 03	16 07	16 10	16 15	16 19	16 24	16 30	16 36	16 43	16 52	17 02
15	17 10	17 14	17 18	17 23	17 29	17 35	17 41	17 48	17 56	18 05	18 16	18 28	18 42	19 00
16	18 24	18 30	18 36	18 43	18 50	18 58	19 06	19 16	19 27	19 39	19 54	20 12	20 34	21 03
17	19 36	19 43	19 50	19 57	20 06	20 15	20 25	20 37	20 50	21 06	21 24	21 47	22 18	23 05
18	20 42	20 48	20 56	21 04	21 13	21 22	21 33	21 46	22 00	22 16	22 36	23 01	23 36	.. ..

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	10 37	10 32	10 26	10 20	10 14	10 07	9 59	9 51	9 41	9 30	9 17	9 01	8 43	8 19
25	11 39	11 35	11 31	11 26	11 22	11 16	11 10	11 04	10 57	10 48	10 39	10 28	10 16	10 00
26	12 39	12 37	12 34	12 31	12 28	12 24	12 20	12 16	12 11	12 05	11 59	11 52	11 44	11 35
27	13 38	13 37	13 35	13 34	13 32	13 30	13 28	13 26	13 23	13 20	13 17	13 14	13 09	13 05
28	14 36	14 36	14 36	14 35	14 35	14 35	14 35	14 34	14 34	14 34	14 33	14 33	14 33	14 32
29	15 33	15 34	15 35	15 37	15 38	15 39	15 41	15 43	15 45	15 47	15 49	15 52	15 55	15 59
30	16 31	16 33	16 36	16 38	16 41	16 44	16 48	16 52	16 56	17 00	17 06	17 12	17 18	17 27
May 1	17 30	17 33	17 37	17 41	17 45	17 50	17 55	18 01	18 08	18 15	18 23	18 33	18 44	18 57
2	18 29	18 34	18 39	18 44	18 50	18 56	19 04	19 11	19 20	19 30	19 42	19 55	20 12	20 32
3	19 29	19 34	19 41	19 47	19 54	20 02	20 11	20 21	20 32	20 45	21 00	21 18	21 40	22 10
4	20 28	20 34	20 41	20 48	20 57	21 06	21 16	21 27	21 40	21 55	22 13	22 35	23 04	23 48
5	21 24	21 30	21 38	21 46	21 54	22 04	22 15	22 27	22 40	22 57	23 16	23 40	.. ..	.. ..
6	22 15	22 22	22 29	22 37	22 45	22 55	23 05	23 17	23 30	23 46	.. ..	.. ..	0 13	1 09
7	23 02	23 08	23 14	23 21	23 29	23 37	23 46	23 57	.. ..	.. ..	0 04	0 27	0 57	1 43
8	23 43	23 48	23 53	23 59	.. ..	.. ..	.. ..	.. ..	0 08	0 22	0 37	0 56	1 20	1 51
9	.. ..	.. ..	.. ..	.. ..	0 05	0 12	0 20	0 28	0 37	0 48	1 00	1 14	1 31	1 52
10	0 19	0 23	0 27	0 31	0 36	0 41	0 47	0 53	1 00	1 08	1 16	1 26	1 38	1 51
11	0 52	0 54	0 57	1 00	1 03	1 06	1 10	1 14	1 18	1 23	1 28	1 34	1 41	1 49
12	1 23	1 24	1 25	1 26	1 27	1 29	1 30	1 32	1 34	1 36	1 38	1 41	1 44	1 47
13	1 53	1 53	1 52	1 52	1 51	1 51	1 50	1 50	1 49	1 48	1 47	1 47	1 46	1 44
14	2 24	2 22	2 20	2 18	2 16	2 14	2 11	2 08	2 05	2 01	1 57	1 53	1 48	1 42
15	2 58	2 55	2 51	2 48	2 44	2 39	2 34	2 29	2 23	2 16	2 09	2 01	1 51	1 39
16	3 37	3 32	3 27	3 22	3 16	3 09	3 02	2 55	2 46	2 36	2 25	2 12	1 56	1 38
17	4 22	4 16	4 09	4 03	3 55	3 47	3 38	3 28	3 16	3 03	2 48	2 30	2 07	1 37
18	5 14	5 07	5 00	4 52	4 44	4 34	4 24	4 12	3 58	3 43	3 24	3 01	2 30	1 42

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	15 45	16 12	16 32	16 49	17 03	17 15	17 36	17 55	18 12	18 29	18 48	19 09	19 22	19 36
	18 16	17 04	17 26	17 44	17 59	18 13	18 35	18 54	19 13	19 31	19 50	20 13	20 26	20 42
	19 17	18 06	18 28	18 46	19 00	19 13	19 35	19 54	20 12	20 30	20 49	21 10	21 23	21 38
	20 18	19 15	19 34	19 50	20 03	20 15	20 35	20 52	21 08	21 24	21 41	22 01	22 12	22 25
	21 20	20 06	20 26	20 42	20 55	21 06	21 16	21 32	21 46	22 00	22 13	22 28	22 44	22 53
	22 21	21 37	21 48	21 58	22 07	22 14	22 27	22 38	22 48	22 58	23 09	23 22	23 29	23 37
	23 22	22 45	22 53	23 00	23 05	23 10	23 18	23 26	23 33	23 40	23 47	23 55	.. ..	.. ..
	24 23	23 52	23 56	23 59	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 00	0 05
	25 ..	.. ..	.. ..	.. ..	0 01	0 04	0 08	0 12	0 15	0 18	0 22	0 26	0 28	0 31
	26 0 57	0 57	0 57	0 57	0 57	0 57	0 56	0 56	0 56	0 56	0 56	0 56	0 56	0 56
27	2 07	2 02	1 58	1 54	1 51	1 49	1 44	1 40	1 37	1 33	1 29	1 25	1 23	1 20
	28 3 17	3 07	2 59	2 52	2 46	2 41	2 33	2 25	2 18	2 11	2 04	1 55	1 51	1 45
	29 4 28	4 13	4 01	3 51	3 42	3 35	3 22	3 11	3 01	2 51	2 40	2 28	2 21	2 12
	30 5 39	5 19	5 03	4 51	4 40	4 30	4 14	3 59	3 46	3 33	3 19	3 03	2 54	2 43
	31 6 50	6 25	6 06	5 51	5 37	5 26	5 07	4 50	4 34	4 18	4 02	3 43	3 32	3 19
June 1	7 57	7 29	7 07	6 50	6 35	6 22	6 01	5 42	5 25	5 07	4 49	4 27	4 15	4 01
	2 8 56	8 27	8 04	7 46	7 31	7 18	6 55	6 36	6 17	5 59	5 40	5 18	5 05	4 50
	3 9 45	9 17	8 55	8 38	8 23	8 10	7 48	7 29	7 12	6 54	6 35	6 13	6 00	5 45
	4 10 23	9 58	9 39	9 24	9 10	8 59	8 39	8 22	8 06	7 50	7 32	7 12	7 01	6 47
	5 10 52	10 32	10 17	10 04	9 53	9 44	9 27	9 13	8 59	8 45	8 31	8 14	8 04	7 53
	6 11 15	11 01	10 49	10 40	10 32	10 24	10 12	10 01	9 51	9 40	9 29	9 17	9 09	9 01
	7 11 33	11 25	11 18	11 12	11 07	11 02	10 54	10 47	10 41	10 34	10 27	10 19	10 15	10 10
	8 11 50	11 47	11 44	11 42	11 40	11 38	11 35	11 33	11 30	11 28	11 25	11 22	11 21	11 19
	9 12 06	12 08	12 10	12 12	12 13	12 14	12 16	12 18	12 20	12 22	12 24	12 26	12 27	12 29
	10 12 23	12 31	12 37	12 42	12 47	12 51	12 58	13 05	13 11	13 17	13 23	13 30	13 35	13 40

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	8 00	7 35	7 15	6 59	6 45	6 34	6 14	5 56	5 40	5 24	5 06	4 47	4 35	4 22
	18 9 17	8 48	8 26	8 08	7 53	7 40	7 18	6 59	6 41	6 23	6 04	5 42	5 29	5 14
	19 10 18	9 49	9 27	9 09	8 54	8 41	8 19	7 59	7 41	7 23	7 04	6 41	6 28	6 13
	20 11 03	10 37	10 17	10 01	9 47	9 35	9 14	8 56	8 39	8 22	8 04	7 43	7 30	7 16
	21 11 36	11 15	10 58	10 44	10 32	10 22	10 04	9 48	9 33	9 18	9 03	8 44	8 33	8 21
	22 12 00	11 44	11 31	11 20	11 10	11 02	10 48	10 35	10 23	10 11	9 59	9 44	9 35	9 26
	23 12 19	12 07	11 58	11 50	11 44	11 38	11 27	11 18	11 10	11 01	10 52	10 41	10 35	10 28
	24 12 34	12 27	12 22	12 17	12 13	12 10	12 04	11 58	11 53	11 48	11 43	11 36	11 32	11 28
	25 12 48	12 46	12 44	12 42	12 41	12 40	12 38	12 36	12 35	12 33	12 31	12 29	12 28	12 27
	26 13 00	13 03	13 05	13 07	13 08	13 09	13 12	13 14	13 16	13 18	13 20	13 22	13 23	13 25
27	13 14	13 21	13 26	13 31	13 35	13 39	13 46	13 51	13 57	14 02	14 08	14 14	14 18	14 22
	28 13 28	13 40	13 50	13 57	14 04	14 10	14 21	14 30	14 39	14 47	14 57	15 07	15 13	15 20
	29 13 46	14 02	14 15	14 26	14 36	14 44	14 58	15 11	15 22	15 34	15 47	16 01	16 10	16 19
	30 14 07	14 29	14 46	14 59	15 11	15 21	15 39	15 54	16 09	16 23	16 39	16 57	17 07	17 19
	31 14 36	15 02	15 22	15 38	15 51	16 03	16 24	16 41	16 58	17 15	17 33	17 53	18 05	18 19
June 1	15 14	15 43	16 05	16 23	16 38	16 51	17 13	17 32	17 50	18 08	18 27	18 49	19 02	19 17
	2 16 05	16 35	16 57	17 15	17 30	17 43	18 06	18 25	18 43	19 01	19 21	19 43	19 56	20 11
	3 17 08	17 36	17 57	18 14	18 28	18 41	19 02	19 21	19 38	19 55	20 13	20 34	20 46	21 00
	4 18 21	18 45	19 03	19 18	19 31	19 42	20 00	20 16	20 31	20 46	21 02	21 20	21 31	21 43
	5 19 41	19 59	20 13	20 25	20 35	20 44	20 59	21 12	21 24	21 36	21 49	22 03	22 11	22 21
	6 21 03	21 16	21 25	21 34	21 41	21 47	21 57	22 06	22 15	22 23	22 32	22 42	22 48	22 55
	7 22 27	22 33	22 38	22 43	22 46	22 50	22 55	23 00	23 05	23 09	23 14	23 19	23 22	23 26
	8 23 51	23 51	23 52	23 52	23 52	23 53	23 53	23 54	23 54	23 54	23 54	23 55	23 55	23 55
	9 ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
	10 1 16	1 10	1 06	1 02	0 59	0 57	0 52	0 48	0 44	0 40	0 36	0 31	0 28	0 25

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	19 36	19 43	19 50	19 57	20 06	20 15	20 25	20 37	20 50	21 06	21 24	21 47	22 18	23 05
18	20 42	20 48	20 56	21 04	21 13	21 22	21 33	21 46	22 00	22 16	22 36	23 01	23 36	.. ..
19	21 38	21 45	21 52	21 59	22 08	22 17	22 27	22 39	22 52	23 08	23 26	23 48	.. ..	0 38
20	22 25	22 31	22 37	22 44	22 51	22 59	23 08	23 18	23 29	23 42	23 57	.. ..	0 18	1 03
21	23 04	23 09	23 14	23 19	23 25	23 32	23 39	23 47	23 56	.. ..	.. ..	0 15	0 37	1 06
22	23 37	23 40	23 44	23 48	23 53	23 58	.. ..	.. ..	.. ..	0 06	0 17	0 30	0 46	1 05
23	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 09	0 15	0 22	0 30	0 40	0 50	1 03
24	0 05	0 08	0 10	0 13	0 16	0 19	0 22	0 26	0 30	0 35	0 40	0 46	0 53	1 00
25	0 31	0 32	0 34	0 35	0 36	0 38	0 40	0 41	0 43	0 46	0 48	0 51	0 54	0 58
26	0 56	0 56	0 55	0 55	0 55	0 55	0 55	0 55	0 55	0 55	0 55	0 55	0 55	0 55
27	1 20	1 19	1 17	1 16	1 14	1 13	1 11	1 09	1 07	1 05	1 02	0 59	0 56	0 52
28	1 45	1 43	1 40	1 37	1 34	1 31	1 28	1 24	1 20	1 15	1 10	1 04	0 58	0 50
29	2 12	2 09	2 05	2 01	1 57	1 52	1 47	1 41	1 35	1 28	1 20	1 11	1 00	0 48
30	2 43	2 39	2 34	2 28	2 22	2 16	2 09	2 02	1 53	1 43	1 32	1 20	1 04	0 46
31	3 19	3 13	3 07	3 01	2 54	2 46	2 37	2 28	2 17	2 05	1 50	1 33	1 13	0 46
June 1	4 01	3 54	3 47	3 40	3 32	3 23	3 13	3 02	2 49	2 35	2 17	1 56	1 29	0 50
2	4 50	4 43	4 35	4 28	4 19	4 09	3 59	3 47	3 33	3 17	2 58	2 34	2 02	1 09
3	5 45	5 39	5 32	5 24	5 15	5 06	4 56	4 44	4 30	4 15	3 56	3 32	3 01	2 11
4	6 47	6 41	6 35	6 28	6 20	6 12	6 02	5 52	5 40	5 26	5 10	4 50	4 25	3 50
5	7 53	7 48	7 43	7 37	7 30	7 24	7 16	7 07	6 58	6 47	6 34	6 20	6 02	5 39
6	9 01	8 57	8 53	8 49	8 44	8 39	8 34	8 27	8 21	8 13	8 04	7 54	7 42	7 27
7	10 10	10 07	10 05	10 02	9 59	9 56	9 53	9 49	9 45	9 40	9 35	9 29	9 22	9 14
8	11 19	11 18	11 17	11 16	11 15	11 14	11 13	11 11	11 10	11 08	11 06	11 04	11 02	10 59
9	12 29	12 29	12 30	12 31	12 32	12 33	12 34	12 35	12 36	12 37	12 39	12 40	12 42	12 45
10	13 40	13 42	13 44	13 47	13 49	13 52	13 56	13 59	14 03	14 07	14 12	14 18	14 25	14 32

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	4 22	4 16	4 09	4 03	3 55	3 47	3 38	3 28	3 16	3 03	2 48	2 30	2 07	1 37
18	5 14	5 07	5 00	4 52	4 44	4 34	4 24	4 12	3 58	3 43	3 24	3 01	2 30	1 42
19	6 13	6 06	5 58	5 50	5 41	5 32	5 21	5 09	4 54	4 38	4 18	3 53	3 19	2 17
20	7 16	7 10	7 03	6 55	6 47	6 38	6 28	6 16	6 03	5 48	5 30	5 08	4 39	3 54
21	8 21	8 16	8 10	8 03	7 56	7 48	7 40	7 30	7 20	7 07	6 53	6 36	6 14	5 46
22	9 26	9 21	9 16	9 11	9 06	9 00	8 53	8 46	8 38	8 28	8 18	8 05	7 50	7 32
23	10 28	10 25	10 21	10 18	10 14	10 10	10 05	10 00	9 54	9 48	9 41	9 32	9 23	9 11
24	11 28	11 26	11 24	11 22	11 20	11 17	11 15	11 12	11 08	11 05	11 01	10 56	10 50	10 44
25	12 27	12 26	12 26	12 25	12 24	12 23	12 23	12 22	12 21	12 19	12 18	12 17	12 15	12 13
26	13 25	13 25	13 26	13 27	13 27	13 28	13 29	13 30	13 31	13 33	13 34	13 36	13 38	13 40
27	14 22	14 24	14 26	14 28	14 31	14 33	14 36	14 39	14 42	14 46	14 50	14 55	15 01	15 07
28	15 20	15 23	15 27	15 30	15 34	15 38	15 43	15 48	15 54	16 00	16 07	16 16	16 25	16 37
29	16 19	16 24	16 28	16 33	16 39	16 45	16 51	16 58	17 06	17 15	17 26	17 38	17 52	18 10
30	17 19	17 25	17 30	17 37	17 43	17 51	17 59	18 08	18 19	18 30	18 44	19 01	19 21	19 47
31	18 19	18 25	18 32	18 39	18 47	18 56	19 05	19 16	19 29	19 43	20 00	20 21	20 48	21 26
June 1	19 17	19 24	19 31	19 39	19 47	19 57	20 07	20 19	20 33	20 49	21 08	21 32	22 04	22 56
2	20 11	20 18	20 25	20 33	20 41	20 51	21 01	21 13	21 27	21 43	22 02	22 25	22 57	23 47
3	21 00	21 06	21 13	21 20	21 28	21 37	21 46	21 57	22 09	22 23	22 40	23 00	23 26	.. ..
4	21 43	21 48	21 54	22 00	22 07	22 14	22 22	22 31	22 41	22 53	23 06	23 21	23 40	0 01
5	22 21	22 25	22 30	22 34	22 40	22 45	22 51	22 58	23 06	23 14	23 24	23 35	23 48	0 04
6	22 55	22 57	23 01	23 04	23 07	23 11	23 15	23 20	23 25	23 31	23 37	23 44	23 52	0 03
7	23 26	23 27	23 29	23 30	23 32	23 34	23 36	23 39	23 41	23 44	23 47	23 51	23 55	0 02
8	23 55	23 55	23 55	23 56	23 56	23 56	23 56	23 56	23 56	23 56	23 56	23 57	23 57	^(00 00) 23 59
9	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55
10	0 25	0 24	0 22	0 21	0 19	0 17	0 16	0 13	0 11	0 09	0 06	0 02	.. ..	23 52

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	11 50	11 47	11 44	11 42	11 40	11 38	11 35	11 33	11 30	11 28	11 25	11 22	11 21	11 19
9	12 06	12 08	12 10	12 12	12 13	12 14	12 16	12 18	12 20	12 22	12 24	12 26	12 27	12 29
10	12 23	12 31	12 37	12 42	12 47	12 51	12 58	13 05	13 11	13 17	13 23	13 30	13 35	13 40
11	12 43	12 56	13 07	13 16	13 24	13 31	13 43	13 53	14 03	14 13	14 24	14 36	14 44	14 52
12	13 07	13 26	13 41	13 54	14 05	14 14	14 31	14 45	14 58	15 12	15 27	15 44	15 53	16 05
13	13 39	14 03	14 22	14 38	14 51	15 03	15 23	15 40	15 56	16 13	16 30	16 51	17 03	17 16
14	14 22	14 50	15 12	15 29	15 44	15 57	16 19	16 38	16 56	17 14	17 33	17 56	18 09	18 24
15	15 18	15 47	16 10	16 28	16 43	16 56	17 18	17 38	17 56	18 14	18 33	18 56	19 09	19 24
16	16 26	16 54	17 14	17 31	17 45	17 57	18 18	18 37	18 53	19 10	19 29	19 49	20 02	20 15
17	17 42	18 05	18 22	18 37	18 49	18 59	19 17	19 33	19 48	20 03	20 18	20 36	20 47	20 58
18	18 59	19 17	19 31	19 42	19 51	20 00	20 14	20 27	20 39	20 50	21 03	21 17	21 25	21 34
19	20 16	20 28	20 37	20 45	20 52	20 58	21 08	21 17	21 25	21 34	21 43	21 53	21 59	22 05
20	21 30	21 36	21 42	21 46	21 50	21 54	21 59	22 05	22 09	22 14	22 20	22 25	22 29	22 33
21	22 41	22 43	22 44	22 45	22 46	22 47	22 49	22 50	22 52	22 53	22 54	22 56	22 57	22 58
22	23 52	23 48	23 46	23 44	23 42	23 40	23 37	23 35	23 33	23 30	23 28	23 25	23 24	23 22
23	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 51	23 47
24	1 01	0 53	0 47	0 41	0 37	0 33	0 26	0 20	0 14	0 08	0 02	.. ..	.. ..	.. ..
25	2 12	1 59	1 48	1 40	1 32	1 26	1 15	1 05	0 56	0 47	0 37	0 27	0 20	0 13
26	3 23	3 05	2 50	2 39	2 29	2 20	2 05	1 52	1 40	1 28	1 15	1 01	0 52	0 43
27	4 34	4 11	3 53	3 38	3 26	3 15	2 57	2 41	2 26	2 12	1 56	1 38	1 28	1 16
28	5 43	5 16	4 55	4 38	4 24	4 12	3 51	3 33	3 16	2 59	2 41	2 21	2 09	1 55
29	6 46	6 16	5 54	5 36	5 21	5 08	4 45	4 26	4 08	3 50	3 31	3 09	2 56	2 41
30	7 40	7 10	6 48	6 30	6 15	6 02	5 40	5 20	5 02	4 44	4 25	4 03	3 50	3 35
July 1	8 22	7 56	7 36	7 19	7 05	6 53	6 32	6 14	5 57	5 41	5 22	5 01	4 49	4 35
2	8 55	8 33	8 16	8 03	7 51	7 40	7 22	7 07	6 52	6 37	6 22	6 04	5 53	5 41

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	23 51	23 51	23 52	23 52	23 52	23 53	23 53	23 54	23 54	23 54	23 54	23 55	23 55	23 55
9	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
10	1 16	1 10	1 06	1 02	0 59	0 57	0 52	0 48	0 44	0 40	0 36	0 31	0 28	0 25
11	2 42	2 31	2 22	2 14	2 07	2 02	1 52	1 43	1 35	1 27	1 19	1 09	1 03	0 57
12	4 10	3 52	3 38	3 27	3 17	3 08	2 54	2 41	2 29	2 17	2 05	1 50	1 42	1 32
13	5 35	5 12	4 54	4 39	4 27	4 16	3 57	3 41	3 26	3 11	2 55	2 36	2 25	2 13
14	6 55	6 27	6 06	5 49	5 34	5 22	5 01	4 42	4 25	4 07	3 49	3 28	3 15	3 01
15	8 03	7 33	7 11	6 53	6 38	6 25	6 02	5 43	5 25	5 06	4 47	4 24	4 11	3 56
16	8 55	8 28	8 06	7 49	7 35	7 22	7 00	6 41	6 24	6 06	5 47	5 25	5 12	4 57
17	9 34	9 10	8 51	8 36	8 23	8 12	7 53	7 36	7 20	7 04	6 47	6 27	6 15	6 02
18	10 02	9 43	9 28	9 16	9 05	8 56	8 40	8 26	8 13	7 59	7 45	7 29	7 19	7 08
19	10 23	10 09	9 58	9 49	9 41	9 34	9 22	9 12	9 01	8 51	8 40	8 28	8 21	8 12
20	10 40	10 31	10 24	10 18	10 13	10 08	10 01	9 54	9 47	9 40	9 33	9 25	9 20	9 15
21	10 54	10 50	10 47	10 44	10 42	10 40	10 36	10 33	10 30	10 27	10 23	10 20	10 17	10 15
22	11 07	11 08	11 09	11 09	11 09	11 10	11 10	11 11	11 11	11 12	11 12	11 13	11 13	11 14
23	11 20	11 26	11 30	11 34	11 37	11 39	11 44	11 48	11 52	11 56	12 01	12 05	12 08	12 11
24	11 34	11 44	11 52	11 59	12 05	12 10	12 19	12 27	12 34	12 41	12 49	12 58	13 03	13 09
25	11 50	12 05	12 17	12 27	12 35	12 42	12 55	13 06	13 17	13 27	13 39	13 52	13 59	14 08
26	12 10	12 30	12 45	12 58	13 08	13 18	13 34	13 49	14 02	14 16	14 30	14 47	14 56	15 07
27	12 36	13 00	13 18	13 34	13 46	13 58	14 17	14 34	14 50	15 06	15 23	15 42	15 54	16 07
28	13 10	13 37	13 59	14 16	14 30	14 43	15 04	15 23	15 41	15 58	16 17	16 39	16 51	17 06
29	13 55	14 25	14 47	15 05	15 21	15 34	15 56	16 16	16 34	16 52	17 12	17 34	17 47	18 02
30	14 54	15 23	15 45	16 03	16 17	16 30	16 52	17 11	17 29	17 46	18 05	18 27	18 39	18 54
July 1	16 05	16 30	16 50	17 06	17 19	17 31	17 51	18 08	18 24	18 40	18 57	19 16	19 27	19 40
2	17 24	17 45	18 01	18 13	18 24	18 34	18 50	19 05	19 18	19 31	19 45	20 01	20 10	20 21

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

47

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	11 19	11 18	11 17	11 16	11 15	11 14	11 13	11 11	11 10	11 08	11 06	11 04	11 02	10 59
9	12 29	12 29	12 30	12 31	12 32	12 33	12 34	12 35	12 36	12 37	12 39	12 40	12 42	12 45
10	13 40	13 42	13 44	13 47	13 49	13 52	13 56	13 59	14 03	14 07	14 12	14 18	14 25	14 32
11	14 52	14 56	15 00	15 04	15 08	15 13	15 19	15 25	15 32	15 40	15 48	15 58	16 10	16 25
12	16 05	16 10	16 15	16 21	16 28	16 35	16 42	16 51	17 01	17 12	17 25	17 40	17 58	18 22
13	17 16	17 23	17 29	17 36	17 44	17 53	18 03	18 13	18 26	18 40	18 57	19 18	19 44	20 22
14	18 24	18 31	18 38	18 46	18 55	19 04	19 15	19 27	19 41	19 57	20 17	20 42	21 15	22 14
15	19 24	19 31	19 38	19 46	19 55	20 04	20 15	20 27	20 41	20 57	21 17	21 41	22 14	23 08
16	20 15	20 22	20 28	20 36	20 44	20 52	21 02	21 13	21 25	21 39	21 56	22 16	22 41	23 17
17	20 58	21 04	21 09	21 16	21 22	21 29	21 37	21 46	21 56	22 07	22 20	22 36	22 54	23 17
18	21 34	21 39	21 43	21 48	21 53	21 58	22 05	22 11	22 19	22 27	22 37	22 48	23 00	23 46
19	22 05	22 08	22 11	22 15	22 18	22 22	22 26	22 31	22 36	22 42	22 48	22 55	23 04	23 13
20	22 33	22 34	22 36	22 38	22 40	22 42	22 45	22 47	22 50	22 53	22 57	23 01	23 05	23 11
21	22 58	22 58	22 59	22 59	23 00	23 00	23 01	23 02	23 02	23 03	23 04	23 05	23 07	23 08
22	23 22	23 21	23 21	23 20	23 19	23 18	23 17	23 16	23 14	23 13	23 11	23 10	23 08	23 05
23	23 47	23 45	23 43	23 41	23 38	23 36	23 33	23 30	23 27	23 23	23 19	23 14	23 09	23 03
24	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 51	23 46	23 41	23 35	23 28	23 20	23 11	23 00
25	0 13	0 10	0 07	0 03	0 00	.. ..	.. ..	.. ..	23 57	23 49	23 39	23 28	23 14	22 59
26	0 43	0 38	0 34	0 29	0 24	0 18	0 12	0 05	.. ..	.. ..	23 54	23 39	23 21	22 58
27	1 16	1 11	1 05	0 59	0 52	0 45	0 37	0 28	0 19	0 07	.. ..	23 58	23 33	23 00
28	1 55	1 49	1 42	1 35	1 27	1 19	1 10	0 59	0 47	0 33	0 17	.. ..	23 58	23 10
29	2 41	2 34	2 27	2 19	2 11	2 02	1 51	1 39	1 26	1 10	0 52	0 28	.. ..	23 52
30	3 35	3 28	3 21	3 13	3 04	2 55	2 44	2 32	2 18	2 02	1 43	1 19	0 46	.. ..
July 1	4 35	4 29	4 22	4 15	4 07	3 58	3 48	3 37	3 24	3 09	2 52	2 31	2 03	1 22
2	5 41	5 36	5 30	5 23	5 17	5 09	5 01	4 51	4 41	4 29	4 15	3 58	3 38	3 11

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	23 55	23 55	23 55	23 56	23 56	23 56	23 56	23 56	23 56	23 56	23 56	23 57	23 57	⁽⁰⁰⁾ _(23 57)
9	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 55
10	0 25	0 24	0 22	0 21	0 19	0 17	0 16	0 13	0 11	0 09	0 06	0 02	.. ..	23 52
11	0 57	0 54	0 51	0 48	0 45	0 41	0 37	0 33	0 28	0 22	0 16	0 09	0 01	23 50
12	1 32	1 28	1 24	1 19	1 14	1 08	1 02	0 55	0 48	0 39	0 30	0 19	0 06	23 49
13	2 13	2 08	2 02	1 56	1 49	1 41	1 33	1 24	1 14	1 02	0 48	0 33	0 13	23 50
14	3 01	2 54	2 48	2 40	2 32	2 23	2 13	2 02	1 49	1 35	1 17	0 56	0 29	.. ..
15	3 56	3 49	3 42	3 34	3 25	3 15	3 04	2 52	2 38	2 22	2 02	1 37	1 03	0 05
16	4 57	4 50	4 43	4 35	4 27	4 17	4 07	3 55	3 41	3 25	3 06	2 42	2 09	1 15
17	6 02	5 56	5 50	5 43	5 35	5 27	5 17	5 07	4 55	4 41	4 25	4 05	3 40	3 06
18	7 08	7 03	6 58	6 52	6 46	6 39	6 31	6 23	6 14	6 03	5 51	5 36	5 18	4 56
19	8 12	8 09	8 05	8 01	7 56	7 51	7 45	7 39	7 32	7 25	7 16	7 06	6 54	6 40
20	9 15	9 12	9 10	9 07	9 04	9 01	8 57	8 53	8 49	8 44	8 39	8 33	8 25	8 17
21	10 15	10 14	10 13	10 11	10 10	10 08	10 07	10 05	10 03	10 01	9 58	9 56	9 52	9 49
22	11 14	11 14	11 14	11 14	11 14	11 14	11 15	11 15	11 15	11 16	11 16	11 16	11 17	11 17
23	12 11	12 13	12 14	12 16	12 18	12 20	12 22	12 24	12 26	12 29	12 32	12 36	12 40	12 45
24	13 09	13 12	13 15	13 18	13 21	13 25	13 29	13 33	13 38	13 43	13 49	13 56	14 04	14 13
25	14 08	14 12	14 16	14 20	14 25	14 30	14 36	14 42	14 49	14 57	15 06	15 17	15 29	15 44
26	15 07	15 12	15 18	15 23	15 30	15 36	15 44	15 52	16 02	16 12	16 25	16 39	16 57	17 19
27	16 07	16 13	16 19	16 26	16 34	16 42	16 51	17 01	17 13	17 26	17 42	18 01	18 25	18 58
28	17 06	17 12	17 20	17 27	17 36	17 45	17 55	18 07	18 20	18 35	18 54	19 17	19 47	20 35
29	18 02	18 09	18 16	18 24	18 33	18 42	18 53	19 05	19 19	19 35	19 54	20 18	20 51	21 45
30	18 54	19 00	19 07	19 15	19 23	19 32	19 42	19 54	20 06	20 21	20 39	21 01	21 29	22 10
July 1	19 40	19 46	19 52	19 58	20 06	20 14	20 22	20 32	20 43	20 55	21 10	21 27	21 48	22 16
2	20 21	20 25	20 30	20 35	20 41	20 47	20 54	21 02	21 10	21 20	21 31	21 43	21 58	22 16

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.		-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
July		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	8 22	7 56	7 36	7 19	7 05	6 53	6 32	6 14	5 57	5 41	5 22	5 01	4 49	4 35	4 35
2	8 55	8 33	8 16	8 03	7 51	7 40	7 22	7 07	6 52	6 37	6 22	6 04	5 53	5 41	5 41
3	9 20	9 04	8 51	8 41	8 31	8 23	8 09	7 57	7 46	7 34	7 22	7 08	6 59	6 50	6 50
4	9 41	9 30	9 22	9 14	9 08	9 03	8 54	8 45	8 37	8 30	8 21	8 12	8 06	8 00	8 00
5	9 58	9 53	9 49	9 46	9 43	9 40	9 36	9 32	9 28	9 24	9 20	9 16	9 13	9 10	9 10
6	10 14	10 15	10 15	10 16	10 16	10 16	10 17	10 17	10 18	10 18	10 19	10 19	10 20	10 20	10 20
7	10 31	10 37	10 42	10 46	10 49	10 53	10 58	11 03	11 08	11 13	11 18	11 24	11 27	11 31	11 31
8	10 49	11 01	11 10	11 18	11 25	11 31	11 41	11 50	11 59	12 08	12 17	12 28	12 35	12 42	12 42
9	11 11	11 28	11 42	11 54	12 03	12 12	12 27	12 40	12 53	13 05	13 18	13 34	13 43	13 53	13 53
10	11 39	12 02	12 20	12 34	12 47	12 58	13 16	13 33	13 48	14 04	14 20	14 40	14 51	15 04	15 04
11	12 17	12 44	13 05	13 22	13 36	13 48	14 10	14 28	14 46	15 03	15 22	15 44	15 56	16 11	16 11
12	13 06	13 36	13 58	14 16	14 31	14 44	15 07	15 26	15 44	16 02	16 22	16 44	16 58	17 13	17 13
13	14 09	14 37	14 59	15 16	15 31	15 44	16 05	16 24	16 42	16 59	17 18	17 40	17 52	18 07	18 07
14	15 21	15 46	16 05	16 20	16 33	16 45	17 04	17 21	17 37	17 53	18 10	18 29	18 40	18 53	18 53
15	16 37	16 57	17 13	17 25	17 36	17 46	18 02	18 16	18 29	18 42	18 56	19 12	19 21	19 32	19 32
16	17 55	18 09	18 20	18 30	18 38	18 45	18 57	19 08	19 18	19 27	19 38	19 50	19 57	20 05	20 05
17	19 10	19 19	19 26	19 32	19 37	19 42	19 50	19 57	20 03	20 10	20 16	20 24	20 29	20 34	20 34
18	20 23	20 27	20 30	20 33	20 35	20 37	20 40	20 43	20 46	20 49	20 52	20 56	20 58	21 00	21 00
19	21 34	21 33	21 32	21 32	21 31	21 31	21 30	21 29	21 28	21 27	21 27	21 26	21 25	21 25	21 25
20	22 45	22 39	22 34	22 30	22 26	22 23	22 18	22 14	22 09	22 05	22 01	21 56	21 53	21 49	21 49
21	23 55	23 44	23 35	23 28	23 22	23 16	23 07	22 59	22 51	22 43	22 35	22 26	22 21	22 15	22 15
22	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 45	23 34	23 23	23 12	22 59	22 51	22 43	22 43
23	1 05	0 49	0 37	0 26	0 17	0 10	.. ..	.. ..	.. ..	.. ..	23 51	23 35	23 25	23 14	23 14
24	2 16	1 55	1 39	1 25	1 14	1 04	0 47	0 33	0 19	0 05	.. ..	.. ..	.. ..	23 50	23 50
25	3 25	3 00	2 40	2 24	2 11	2 00	1 40	1 23	1 07	0 51	0 34	0 14	0 03	.. ..	.. ..

MOONSET

July		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	16 05	16 30	16 50	17 06	17 19	17 31	17 51	18 08	18 24	18 40	18 57	19 16	19 27	19 40	19 40
2	17 24	17 45	18 01	18 13	18 24	18 34	18 50	19 05	19 18	19 31	19 45	20 01	20 10	20 21	20 21
3	18 48	19 02	19 14	19 23	19 31	19 38	19 50	20 01	20 10	20 20	20 30	20 42	20 49	20 56	20 56
4	20 13	20 21	20 28	20 33	20 38	20 42	20 49	20 56	21 02	21 07	21 13	21 20	21 24	21 29	21 29
5	21 38	21 40	21 42	21 44	21 45	21 46	21 48	21 50	21 52	21 53	21 55	21 57	21 58	21 59	21 59
6	23 03	22 59	22 56	22 54	22 52	22 50	22 47	22 44	22 41	22 39	22 36	22 33	22 31	22 29	22 29
7	.. ..	.. ..	.. ..	.. ..	23 59	23 54	23 46	23 39	23 32	23 25	23 18	23 10	23 05	23 00	23 00
8	0 28	0 19	0 11	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 49	23 42	23 34	23 34
9	1 54	1 38	1 26	1 16	1 07	1 00	0 46	0 35	0 24	0 14	0 02	.. ..	.. ..	.. ..	.. ..
10	3 19	2 57	2 41	2 27	2 15	2 05	1 48	1 33	1 19	1 05	0 50	0 33	0 23	0 11	0 11
11	4 39	4 13	3 53	3 36	3 22	3 10	2 50	2 32	2 15	1 59	1 41	1 21	1 09	0 55	0 55
12	5 50	5 21	4 59	4 41	4 26	4 13	3 51	3 32	3 14	2 56	2 36	2 14	2 01	1 46	1 46
13	6 48	6 19	5 57	5 39	5 24	5 11	4 49	4 30	4 12	3 54	3 34	3 12	2 59	2 44	2 44
14	7 31	7 05	6 46	6 29	6 16	6 04	5 43	5 25	5 09	4 52	4 34	4 13	4 00	3 46	3 46
15	8 03	7 42	7 25	7 12	7 00	6 50	6 32	6 17	6 02	5 48	5 32	5 14	5 04	4 51	4 51
16	8 27	8 11	7 58	7 47	7 38	7 30	7 16	7 04	6 53	6 41	6 29	6 14	6 06	5 56	5 56
17	8 45	8 34	8 26	8 18	8 12	8 06	7 57	7 48	7 40	7 32	7 23	7 13	7 07	7 00	7 00
18	9 01	8 55	8 50	8 46	8 42	8 39	8 34	8 29	8 24	8 19	8 14	8 09	8 05	8 02	8 02
19	9 15	9 13	9 12	9 11	9 11	9 10	9 09	9 08	9 06	9 05	9 04	9 03	9 02	9 01	9 01
20	9 28	9 31	9 34	9 36	9 38	9 40	9 43	9 45	9 48	9 50	9 53	9 56	9 58	10 00	10 00
21	9 41	9 49	9 56	10 01	10 06	10 10	10 17	10 23	10 29	10 35	10 42	10 49	10 53	10 58	10 58
22	9 57	10 09	10 19	10 28	10 35	10 41	10 53	11 02	11 12	11 21	11 31	11 42	11 49	11 56	11 56
23	10 14	10 32	10 46	10 57	11 07	11 15	11 30	11 43	11 55	12 08	12 21	12 36	12 45	12 55	12 55
24	10 37	10 59	11 16	11 30	11 42	11 53	12 11	12 27	12 42	12 56	13 12	13 31	13 41	13 54	13 54
25	11 07	11 33	11 53	12 09	12 23	12 35	12 56	13 14	13 31	13 47	14 05	14 26	14 38	14 52	14 52

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

49

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
July 1	h m 4 35	h m 4 29	h m 4 22	h m 4 15	h m 4 07	h m 3 58	h m 3 48	h m 3 37	h m 3 24	h m 3 09	h m 2 52	h m 2 31	h m 2 03	h m 1 22
2	5 41	5 36	5 30	5 23	5 17	5 09	5 01	4 51	4 41	4 29	4 15	3 58	3 38	3 11
3	6 50	6 46	6 41	6 36	6 31	6 25	6 19	6 12	6 04	5 55	5 45	5 33	5 20	5 02
4	8 00	7 57	7 54	7 51	7 47	7 44	7 40	7 35	7 30	7 24	7 18	7 11	7 02	6 52
5	9 10	9 09	9 07	9 06	9 04	9 03	9 01	8 59	8 56	8 54	8 51	8 47	8 44	8 39
6	10 20	10 21	10 21	10 21	10 21	10 22	10 22	10 22	10 23	10 23	10 23	10 24	10 25	10 25
7	11 31	11 33	11 34	11 36	11 39	11 41	11 43	11 46	11 49	11 53	11 57	12 01	12 06	12 12
8	12 42	12 45	12 49	12 52	12 56	13 01	13 05	13 11	13 17	13 23	13 31	13 39	13 49	14 01
9	13 53	13 58	14 03	14 08	14 14	14 20	14 27	14 35	14 44	14 54	15 05	15 19	15 35	15 54
10	15 04	15 10	15 16	15 23	15 30	15 38	15 47	15 57	16 09	16 22	16 37	16 56	17 19	17 51
11	16 11	16 18	16 25	16 33	16 41	16 50	17 01	17 13	17 26	17 42	18 01	18 24	18 55	19 45
12	17 13	17 20	17 27	17 35	17 44	17 54	18 05	18 17	18 31	18 47	19 07	19 32	20 06	21 06
13	18 07	18 14	18 21	18 28	18 37	18 46	18 56	19 07	19 20	19 35	19 53	20 16	20 44	21 27
14	18 53	18 59	19 05	19 12	19 19	19 27	19 35	19 45	19 56	20 09	20 23	20 41	21 02	21 30
15	19 32	19 36	19 41	19 47	19 53	19 59	20 06	20 13	20 22	20 32	20 43	20 55	21 11	21 29
16	20 05	20 08	20 12	20 16	20 20	20 25	20 30	20 35	20 41	20 48	20 56	21 05	21 15	21 27
17	20 34	20 36	20 38	20 41	20 43	20 46	20 50	20 53	20 57	21 01	21 06	21 11	21 18	21 25
18	21 00	21 01	21 02	21 03	21 04	21 05	21 07	21 08	21 10	21 12	21 14	21 16	21 19	21 22
19	21 25	21 25	21 24	21 24	21 24	21 23	21 23	21 23	21 22	21 22	21 21	21 21	21 20	21 20
20	21 49	21 48	21 47	21 45	21 43	21 41	21 39	21 37	21 35	21 32	21 29	21 25	21 22	21 17
21	22 15	22 13	22 10	22 07	22 04	22 00	21 56	21 52	21 48	21 43	21 37	21 31	21 23	21 15
22	22 43	22 39	22 35	22 31	22 26	22 21	22 16	22 10	22 03	21 56	21 47	21 37	21 26	21 13
23	23 14	23 09	23 04	22 59	22 53	22 46	22 39	22 31	22 22	22 12	22 00	21 47	21 31	21 12
24	23 50	23 44	23 38	23 32	23 24	23 16	23 08	22 58	22 47	22 34	22 20	22 02	21 40	21 12
25	.. ..	.. ..	.. ..	.. ..	.. ..	23 54	23 44	23 33	23 20	23 06	22 48	22 26	21 59	21 18

MOONSET

July 1	h m 19 40	h m 19 46	h m 19 52	h m 19 58	h m 20 06	h m 20 14	h m 20 22	h m 20 32	h m 20 43	h m 20 55	h m 21 10	h m 21 27	h m 21 48	h m 22 16
2	20 21	20 25	20 30	20 35	20 41	20 47	20 54	21 02	21 10	21 20	21 31	21 43	21 58	22 16
3	20 56	21 00	21 03	21 07	21 11	21 16	21 20	21 26	21 32	21 38	21 46	21 54	22 04	22 15
4	21 29	21 31	21 33	21 35	21 37	21 40	21 43	21 46	21 49	21 53	21 57	22 02	22 07	22 13
5	21 59	22 00	22 00	22 01	22 01	22 02	22 03	22 04	22 05	22 06	22 07	22 08	22 09	22 11
6	22 29	22 28	22 27	22 26	22 25	22 24	22 22	22 21	22 20	22 18	22 16	22 14	22 11	22 08
7	23 00	22 58	22 55	22 52	22 50	22 46	22 43	22 39	22 35	22 31	22 26	22 20	22 14	22 06
8	23 34	23 30	23 26	23 22	23 17	23 12	23 06	23 00	22 54	22 46	22 38	22 28	22 17	22 04
9	.. ..	.. ..	.. ..	23 55	23 49	23 42	23 35	23 26	23 17	23 06	22 54	22 40	22 23	22 02
10	0 11	0 06	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	23 48	23 34	23 18	22 59	22 35	22 03
11	0 55	0 49	0 43	0 36	0 28	0 19	0 10	0 00	.. ..	.. ..	23 55	23 31	23 00	22 09
12	1 46	1 39	1 32	1 24	1 16	1 06	0 56	0 44	0 30	0 14	.. ..	.. ..	23 51	22 51
13	2 44	2 37	2 30	2 22	2 13	2 03	1 52	1 40	1 26	1 10	0 50	0 25	.. ..	.. ..
14	3 46	3 40	3 33	3 26	3 18	3 09	2 59	2 48	2 35	2 20	2 02	1 40	1 12	0 30
15	4 51	4 46	4 40	4 34	4 27	4 19	4 11	4 02	3 51	3 39	3 25	3 08	2 47	2 20
16	5 56	5 52	5 48	5 43	5 37	5 32	5 25	5 18	5 10	5 01	4 51	4 39	4 24	4 07
17	7 00	6 57	6 54	6 50	6 47	6 43	6 38	6 33	6 28	6 22	6 15	6 07	5 58	5 47
18	8 02	8 00	7 58	7 56	7 54	7 52	7 49	7 47	7 44	7 40	7 37	7 32	7 27	7 22
19	9 01	9 01	9 00	9 00	9 00	8 59	8 58	8 58	8 57	8 56	8 55	8 54	8 53	8 52
20	10 00	10 01	10 02	10 03	10 04	10 05	10 06	10 08	10 09	10 11	10 13	10 15	10 17	10 20
21	10 58	11 00	11 02	11 05	11 07	11 10	11 13	11 17	11 20	11 25	11 29	11 35	11 41	11 48
22	11 56	11 59	12 03	12 07	12 11	12 15	12 20	12 26	12 32	12 39	12 46	12 55	13 05	13 18
23	12 55	12 59	13 04	13 09	13 15	13 21	13 28	13 35	13 43	13 53	14 04	14 17	14 32	14 50
24	13 54	13 59	14 05	14 12	14 18	14 26	14 35	14 44	14 55	15 07	15 21	15 38	15 59	16 26
25	14 52	14 59	15 05	15 13	15 21	15 30	15 39	15 51	16 03	16 18	16 35	16 56	17 24	18 04

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	2 16	1 55	1 39	1 25	1 14	1 04	0 47	0 33	0 19	0 05	.. ..	.. ..	.. ..	23 50
25	3 25	3 00	2 40	2 24	2 11	2 00	1 40	1 23	1 07	0 51	0 34	0 14	0 03	.. ..
26	4 31	4 02	3 40	3 23	3 08	2 55	2 33	2 15	1 57	1 40	1 21	0 59	0 47	0 33
27	5 28	4 59	4 36	4 18	4 03	3 50	3 28	3 08	2 50	2 32	2 13	1 50	1 37	1 22
28	6 16	5 48	5 27	5 10	4 55	4 43	4 21	4 02	3 45	3 27	3 08	2 47	2 34	2 19
29	6 54	6 30	6 11	5 56	5 43	5 32	5 13	4 56	4 40	4 24	4 07	3 48	3 36	3 23
30	7 22	7 04	6 49	6 37	6 27	6 17	6 02	5 48	5 35	5 22	5 08	4 52	4 43	4 32
31	7 45	7 32	7 22	7 13	7 06	6 59	6 48	6 38	6 29	6 19	6 09	5 57	5 51	5 43
Aug. 1	8 04	7 57	7 51	7 47	7 42	7 39	7 32	7 26	7 21	7 16	7 10	7 03	6 59	6 55
2	8 22	8 20	8 19	8 18	8 17	8 16	8 15	8 14	8 13	8 11	8 10	8 09	8 08	8 07
3	8 39	8 43	8 46	8 49	8 51	8 53	8 57	9 01	9 04	9 07	9 11	9 15	9 17	9 20
4	8 57	9 07	9 14	9 21	9 27	9 32	9 41	9 48	9 56	10 03	10 11	10 21	10 26	10 32
5	9 18	9 33	9 46	9 56	10 05	10 12	10 26	10 38	10 49	11 00	11 13	11 27	11 35	11 44
6	9 44	10 05	10 21	10 35	10 47	10 57	11 14	11 30	11 44	11 59	12 14	12 32	12 43	12 55
7	10 18	10 44	11 04	11 20	11 34	11 46	12 06	12 24	12 41	12 58	13 16	13 37	13 49	14 03
8	11 03	11 32	11 53	12 11	12 26	12 39	13 01	13 20	13 38	13 56	14 15	14 38	14 51	15 06
9	12 00	12 29	12 51	13 08	13 23	13 36	13 58	14 17	14 35	14 53	15 12	15 34	15 47	16 02
10	13 07	13 34	13 54	14 10	14 24	14 36	14 56	15 14	15 30	15 47	16 04	16 24	16 36	16 50
11	14 21	14 43	15 00	15 14	15 25	15 36	15 53	16 08	16 22	16 37	16 52	17 09	17 19	17 30
12	15 37	15 54	16 07	16 18	16 27	16 35	16 48	17 00	17 12	17 23	17 35	17 48	17 56	18 05
13	16 53	17 04	17 13	17 20	17 26	17 32	17 42	17 50	17 58	18 06	18 14	18 24	18 29	18 35
14	18 06	18 12	18 17	18 21	18 25	18 28	18 33	18 38	18 42	18 46	18 51	18 56	18 59	19 02
15	19 18	19 19	19 20	19 21	19 21	19 22	19 23	19 23	19 24	19 25	19 26	19 27	19 27	19 28
16	20 29	20 25	20 22	20 19	20 17	20 15	20 11	20 08	20 06	20 03	20 00	19 57	19 55	19 53
17	21 39	21 30	21 23	21 17	21 12	21 08	21 00	20 53	20 47	20 41	20 35	20 27	20 23	20 18

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	10 37	10 59	11 16	11 30	11 42	11 53	12 11	12 27	12 42	12 56	13 12	13 31	13 41	13 54
25	11 07	11 33	11 53	12 09	12 23	12 35	12 56	13 14	13 31	13 47	14 05	14 26	14 38	14 52
26	11 46	12 15	12 37	12 55	13 10	13 23	13 45	14 04	14 22	14 40	14 59	15 22	15 35	15 49
27	12 38	13 08	13 30	13 48	14 03	14 17	14 39	14 58	15 16	15 34	15 53	16 15	16 28	16 43
28	13 44	14 11	14 32	14 49	15 03	15 15	15 36	15 54	16 11	16 28	16 46	17 06	17 18	17 32
29	15 01	15 24	15 41	15 55	16 08	16 18	16 36	16 52	17 06	17 21	17 36	17 54	18 04	18 15
30	16 24	16 41	16 55	17 06	17 15	17 23	17 37	17 49	18 01	18 12	18 24	18 37	18 45	18 54
31	17 51	18 01	18 10	18 17	18 23	18 29	18 38	18 46	18 54	19 01	19 09	19 18	19 23	19 29
Aug. 1	19 18	19 23	19 26	19 30	19 32	19 35	19 39	19 42	19 46	19 49	19 52	19 56	19 58	20 01
2	20 45	20 44	20 43	20 42	20 41	20 40	20 39	20 38	20 37	20 36	20 35	20 33	20 33	20 32
3	22 13	22 05	21 59	21 54	21 50	21 46	21 39	21 34	21 28	21 23	21 17	21 11	21 07	21 03
4	23 40	23 26	23 15	23 06	22 59	22 52	22 40	22 30	22 21	22 12	22 02	21 50	21 44	21 36
5	.. ..	.. ..	.. ..	.. ..	.. ..	23 58	23 42	23 28	23 15	23 02	22 48	22 33	22 23	22 13
6	1 06	0 46	0 31	0 18	0 07	.. ..	.. ..	.. ..	.. ..	23 55	23 38	23 19	23 08	22 55
7	2 27	2 03	1 43	1 28	1 15	1 03	0 44	0 27	0 11	.. ..	.. ..	.. ..	23 57	23 43
8	3 41	3 13	2 51	2 34	2 19	2 06	1 45	1 26	1 08	0 51	0 32	0 10	.. ..	.. ..
9	4 42	4 13	3 51	3 33	3 18	3 05	2 43	2 24	2 06	1 47	1 28	1 06	0 53	0 37
10	5 29	5 02	4 42	4 25	4 11	3 59	3 37	3 19	3 02	2 44	2 26	2 04	1 52	1 37
11	6 04	5 42	5 24	5 09	4 57	4 46	4 27	4 11	3 56	3 40	3 24	3 04	2 53	2 40
12	6 31	6 13	5 59	5 47	5 37	5 28	5 13	4 59	4 46	4 34	4 20	4 04	3 55	3 44
13	6 51	6 38	6 28	6 19	6 12	6 05	5 54	5 44	5 34	5 25	5 14	5 02	4 56	4 48
14	7 08	7 00	6 53	6 48	6 43	6 39	6 32	6 25	6 19	6 13	6 07	5 59	5 55	5 50
15	7 22	7 19	7 16	7 14	7 12	7 11	7 08	7 05	7 02	7 00	6 57	6 54	6 52	6 50
16	7 36	7 37	7 38	7 39	7 40	7 41	7 42	7 43	7 44	7 45	7 46	7 47	7 48	7 49
17	7 49	7 55	8 00	8 04	8 08	8 11	8 16	8 21	8 26	8 30	8 35	8 40	8 44	8 47

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

51

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	23 50	23 44	23 38	23 32	23 24	23 16	23 08	22 58	22 47	22 34	22 20	22 02	21 40	21 12
25	.. ..	.. ..	.. ..	.. ..	.. ..	23 54	23 44	23 33	23 20	23 06	22 48	22 26	21 59	21 18
26	0 33	0 26	0 19	0 12	0 03	.. ..	.. ..	.. ..	.. ..	23 50	23 31	23 07	22 34	21 42
27	1 22	1 15	1 08	1 00	0 52	0 42	0 32	0 20	0 06	.. ..	.. ..	.. ..	23 38	22 51
28	2 19	2 13	2 06	1 58	1 50	1 41	1 30	1 19	1 05	0 50	0 31	0 09	.. ..	.. ..
29	3 23	3 17	3 11	3 04	2 57	2 49	2 40	2 29	2 18	2 05	1 49	1 30	1 06	0 34
30	4 32	4 27	4 22	4 17	4 11	4 04	3 57	3 49	3 40	3 30	3 18	3 04	2 47	2 26
31	5 43	5 40	5 36	5 32	5 28	5 23	5 18	5 13	5 06	4 59	4 51	4 42	4 32	4 19
Aug. 1	6 55	6 53	6 51	6 49	6 47	6 44	6 41	6 38	6 35	6 31	6 27	6 22	6 16	6 10
2	8 07	8 07	8 07	8 06	8 06	8 05	8 05	8 04	8 04	8 03	8 02	8 01	8 00	7 59
3	9 20	9 21	9 22	9 24	9 25	9 27	9 28	9 30	9 32	9 35	9 37	9 40	9 44	9 48
4	10 32	10 35	10 38	10 41	10 44	10 48	10 52	10 56	11 01	11 07	11 13	11 20	11 28	11 38
5	11 44	11 48	11 53	11 58	12 03	12 09	12 15	12 22	12 30	12 38	12 48	13 00	13 14	13 31
6	12 55	13 01	13 06	13 13	13 20	13 27	13 36	13 45	13 55	14 07	14 22	14 38	14 59	15 26
7	14 03	14 10	14 16	14 24	14 32	14 41	14 51	15 02	15 15	15 30	15 48	16 09	16 38	17 20
8	15 06	15 13	15 20	15 28	15 37	15 46	15 57	16 09	16 23	16 39	16 59	17 24	17 57	18 54
9	16 02	16 08	16 16	16 23	16 32	16 41	16 52	17 03	17 17	17 33	17 51	18 14	18 45	19 33
10	16 50	16 56	17 02	17 09	17 17	17 25	17 34	17 45	17 57	18 10	18 26	18 45	19 09	19 41
11	17 30	17 35	17 41	17 47	17 53	18 00	18 07	18 16	18 25	18 36	18 48	19 03	19 20	19 41
12	18 05	18 09	18 13	18 18	18 22	18 28	18 33	18 40	18 47	18 55	19 04	19 14	19 26	19 40
13	18 35	18 38	18 41	18 44	18 47	18 51	18 55	18 59	19 04	19 09	19 15	19 22	19 30	19 39
14	19 02	19 04	19 05	19 07	19 09	19 11	19 13	19 15	19 18	19 21	19 24	19 28	19 32	19 36
15	19 28	19 28	19 28	19 29	19 29	19 29	19 30	19 30	19 31	19 31	19 32	19 32	19 33	19 34
16	19 53	19 52	19 51	19 50	19 49	19 47	19 46	19 45	19 43	19 41	19 39	19 37	19 35	19 32
17	20 18	20 16	20 14	20 11	20 09	20 06	20 03	20 00	19 56	19 52	19 47	19 42	19 36	19 30

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	13 54	13 59	14 05	14 12	14 18	14 26	14 35	14 44	14 55	15 07	15 21	15 38	15 59	16 26
25	14 52	14 59	15 05	15 13	15 21	15 30	15 39	15 51	16 03	16 18	16 35	16 56	17 24	18 04
26	15 49	15 56	16 03	16 11	16 20	16 29	16 40	16 52	17 05	17 21	17 41	18 04	18 37	19 29
27	16 43	16 50	16 57	17 05	17 13	17 23	17 33	17 45	17 58	18 14	18 32	18 56	19 26	20 13
28	17 32	17 38	17 45	17 52	17 59	18 08	18 17	18 28	18 40	18 53	19 09	19 29	19 53	20 26
29	18 15	18 21	18 26	18 32	18 38	18 46	18 53	19 02	19 11	19 22	19 35	19 49	20 07	20 28
30	18 54	18 58	19 02	19 07	19 11	19 17	19 22	19 29	19 36	19 43	19 52	20 02	20 14	20 28
31	19 29	19 31	19 34	19 37	19 40	19 43	19 47	19 51	19 55	20 00	20 05	20 12	20 19	20 27
Aug. 1	20 01	20 02	20 03	20 04	20 05	20 07	20 08	20 10	20 12	20 14	20 16	20 19	20 22	20 25
2	20 32	20 31	20 31	20 30	20 30	20 29	20 29	20 28	20 28	20 27	20 26	20 25	20 24	20 23
3	21 03	21 01	20 59	20 57	20 55	20 52	20 50	20 47	20 44	20 40	20 36	20 32	20 27	20 21
4	21 36	21 33	21 29	21 26	21 22	21 17	21 13	21 07	21 02	20 55	20 48	20 40	20 30	20 19
5	22 13	22 08	22 03	21 58	21 52	21 46	21 39	21 32	21 23	21 14	21 03	20 50	20 35	20 17
6	22 55	22 49	22 43	22 36	22 29	22 21	22 12	22 03	21 52	21 39	21 24	21 07	20 45	20 18
7	23 43	23 36	23 29	23 22	23 13	23 04	22 54	22 43	22 30	22 14	21 56	21 34	21 05	20 23
8	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 46	23 34	23 20	23 04	22 44	22 19	21 46	20 49
9	0 37	0 31	0 23	0 15	0 06	.. ..	.. ..	.. ..	.. ..	.. ..	23 49	23 26	22 56	22 09
10	1 37	1 31	1 24	1 16	1 08	0 58	0 48	0 36	0 23	0 08	.. ..	.. ..	.. ..	23 54
11	2 40	2 34	2 28	2 22	2 14	2 06	1 57	1 47	1 36	1 23	1 07	0 49	0 26	.. ..
12	3 44	3 40	3 35	3 29	3 23	3 17	3 10	3 02	2 53	2 43	2 31	2 17	2 01	1 40
13	4 48	4 44	4 41	4 37	4 32	4 27	4 22	4 17	4 10	4 03	3 55	3 45	3 34	3 21
14	5 50	5 47	5 45	5 43	5 40	5 37	5 34	5 30	5 26	5 22	5 17	5 11	5 04	4 57
15	6 50	6 49	6 48	6 47	6 46	6 45	6 43	6 42	6 40	6 38	6 36	6 34	6 31	6 28
16	7 49	7 49	7 50	7 50	7 51	7 51	7 51	7 52	7 53	7 53	7 54	7 55	7 56	7 57
17	8 47	8 49	8 51	8 52	8 54	8 56	8 59	9 01	9 04	9 07	9 11	9 15	9 19	9 25

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	20 29	20 25	20 22	20 19	20 17	20 15	20 11	20 08	20 06	20 03	20 00	19 57	19 55	19 53
17	21 39	21 30	21 23	21 17	21 12	21 08	21 00	20 53	20 47	20 41	20 35	20 27	20 23	20 18
18	22 49	22 35	22 24	22 15	22 08	22 01	21 49	21 39	21 30	21 20	21 10	20 59	20 52	20 45
19	23 59	23 40	23 26	23 14	23 03	22 55	22 39	22 26	22 13	22 01	21 48	21 33	21 24	21 15
20	.. ..	.. ..	.. ..	.. ..	.. ..	23 49	23 30	23 14	22 59	22 45	22 29	22 11	22 00	21 48
21	1 08	0 45	0 27	0 12	0 00	.. ..	.. ..	.. ..	23 48	23 31	23 13	22 53	22 41	22 27
22	2 14	1 47	1 27	1 10	0 56	0 44	0 23	0 05	.. ..	.. ..	.. ..	23 40	23 27	23 13
23	3 15	2 45	2 23	2 06	1 51	1 38	1 16	0 57	0 39	0 21	0 02	.. ..	.. ..	.. ..
24	4 06	3 38	3 16	2 58	2 43	2 30	2 08	1 49	1 32	1 14	0 55	0 33	0 20	0 05
25	4 48	4 22	4 02	3 46	3 32	3 21	3 00	2 42	2 26	2 09	1 51	1 31	1 19	1 05
26	5 20	4 59	4 43	4 29	4 18	4 07	3 50	3 35	3 20	3 06	2 51	2 33	2 22	2 11
27	5 46	5 31	5 18	5 08	4 59	4 51	4 38	4 26	4 14	4 03	3 51	3 37	3 29	3 20
28	6 08	5 58	5 50	5 43	5 37	5 32	5 23	5 15	5 08	5 01	4 53	4 44	4 38	4 32
29	6 26	6 22	6 19	6 16	6 13	6 11	6 07	6 04	6 01	5 58	5 54	5 51	5 48	5 46
30	6 44	6 46	6 47	6 48	6 49	6 50	6 51	6 52	6 54	6 55	6 56	6 58	6 59	7 00
31	7 03	7 10	7 16	7 21	7 25	7 29	7 36	7 42	7 47	7 53	7 59	8 06	8 10	8 15
Sept. 1	7 23	7 36	7 47	7 56	8 03	8 10	8 22	8 32	8 42	8 52	9 02	9 14	9 21	9 29
2	7 49	8 07	8 22	8 35	8 45	8 54	9 11	9 25	9 38	9 51	10 06	10 22	10 32	10 43
3	8 21	8 45	9 03	9 19	9 32	9 43	10 02	10 19	10 35	10 52	11 09	11 29	11 40	11 54
4	9 03	9 30	9 51	10 09	10 23	10 36	10 57	11 16	11 33	11 51	12 10	12 32	12 45	12 59
5	9 56	10 25	10 47	11 04	11 19	11 32	11 54	12 13	12 31	12 49	13 08	13 30	13 43	13 58
6	11 00	11 27	11 48	12 04	12 18	12 31	12 51	13 09	13 26	13 43	14 01	14 22	14 34	14 48
7	12 12	12 35	12 52	13 07	13 19	13 30	13 48	14 04	14 19	14 34	14 50	15 08	15 18	15 30
8	13 26	13 44	13 58	14 10	14 20	14 28	14 43	14 56	15 08	15 21	15 33	15 48	15 57	16 06
9	14 40	14 53	15 03	15 12	15 19	15 26	15 37	15 46	15 55	16 04	16 13	16 24	16 30	16 38

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	7 36	7 37	7 38	7 39	7 40	7 41	7 42	7 43	7 44	7 45	7 46	7 47	7 48	7 49
17	7 49	7 55	8 00	8 04	8 08	8 11	8 16	8 21	8 26	8 30	8 35	8 40	8 44	8 47
18	8 04	8 15	8 23	8 30	8 36	8 42	8 51	9 00	9 08	9 15	9 24	9 33	9 39	9 45
19	8 21	8 36	8 48	8 58	9 07	9 15	9 28	9 40	9 51	10 02	10 13	10 27	10 35	10 43
20	8 41	9 01	9 17	9 30	9 41	9 50	10 07	10 22	10 35	10 49	11 04	11 21	11 31	11 42
21	9 07	9 32	9 50	10 06	10 19	10 30	10 50	11 07	11 23	11 38	11 56	12 15	12 27	12 40
22	9 42	10 09	10 31	10 48	11 02	11 15	11 36	11 55	12 12	12 30	12 48	13 10	13 22	13 37
23	10 27	10 57	11 19	11 37	11 52	12 05	12 27	12 46	13 04	13 22	13 41	14 03	14 16	14 31
24	11 26	11 54	12 15	12 33	12 47	13 00	13 21	13 40	13 57	14 15	14 33	14 55	15 07	15 21
25	12 36	13 01	13 20	13 35	13 49	14 00	14 19	14 36	14 52	15 07	15 24	15 43	15 54	16 07
26	13 55	14 15	14 31	14 43	14 54	15 03	15 19	15 33	15 46	15 59	16 13	16 28	16 37	16 47
27	15 20	15 34	15 45	15 54	16 02	16 09	16 20	16 31	16 40	16 49	16 59	17 10	17 17	17 24
28	16 48	16 56	17 02	17 07	17 12	17 15	17 22	17 28	17 33	17 38	17 44	17 50	17 54	17 58
29	18 18	18 19	18 20	18 21	18 22	18 23	18 24	18 25	18 26	18 27	18 28	18 29	18 29	18 30
30	19 47	19 43	19 39	19 36	19 33	19 30	19 26	19 22	19 19	19 15	19 12	19 08	19 05	19 02
31	21 17	21 06	20 58	20 50	20 44	20 38	20 29	20 21	20 13	20 05	19 57	19 48	19 42	19 36
Sept. 1	22 47	22 29	22 16	22 05	21 55	21 47	21 32	21 20	21 08	20 57	20 44	20 30	20 22	20 13
2	.. ..	23 49	23 32	23 17	23 05	22 54	22 36	22 20	22 05	21 50	21 35	21 17	21 06	20 54
3	0 12	.. ..	.. ..	.. ..	.. ..	23 59	23 38	23 20	23 03	22 46	22 28	22 07	21 55	21 41
4	1 30	1 03	0 42	0 26	0 11	.. ..	.. ..	.. ..	.. ..	23 43	23 24	23 02	22 49	22 34
5	2 36	2 07	1 45	1 28	1 13	1 00	0 38	0 19	0 01	.. ..	.. ..	.. ..	23 47	23 32
6	3 27	3 00	2 39	2 22	2 08	1 55	1 34	1 15	0 58	0 40	0 21	0 00	.. ..	.. ..
7	4 06	3 42	3 24	3 08	2 55	2 44	2 25	2 08	1 52	1 36	1 19	0 59	0 47	0 34
8	4 35	4 15	4 00	3 48	3 37	3 27	3 11	2 57	2 43	2 30	2 15	1 58	1 48	1 37
9	4 57	4 42	4 31	4 21	4 13	4 06	3 53	3 42	3 31	3 21	3 09	2 56	2 49	2 40

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
Aug. 16	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
17	19 53	19 52	19 51	19 50	19 49	19 47	19 46	19 45	19 43	19 41	19 39	19 37	19 35	19 32
18	20 18	20 16	20 14	20 11	20 09	20 06	20 03	20 00	19 56	19 52	19 47	19 42	19 36	19 30
19	20 45	20 42	20 38	20 35	20 31	20 26	20 21	20 16	20 10	20 04	19 57	19 49	19 39	19 28
20	21 15	21 10	21 06	21 01	20 55	20 49	20 43	20 36	20 28	20 19	20 09	19 57	19 43	19 27
21	21 48	21 43	21 37	21 31	21 24	21 17	21 09	21 00	20 50	20 39	20 25	20 10	19 51	19 27
22	22 27	22 21	22 14	22 07	22 00	21 51	21 42	21 31	21 19	21 05	20 49	20 30	20 05	19 32
23	23 13	23 06	22 59	22 51	22 43	22 33	22 23	22 12	21 58	21 43	21 25	21 02	20 32	19 46
24	.. ..	23 59	23 51	23 44	23 35	23 26	23 15	23 04	22 50	22 34	22 16	21 52	21 21	20 32
25	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 41	23 24	23 04	22 37	21 59
26	1 05	0 59	0 52	0 45	0 37	0 28	0 19	0 08	.. ..	.. ..	.. ..	.. ..	.. ..	23 46
27	2 11	2 05	2 00	1 53	1 47	1 39	1 31	1 22	1 12	1 00	0 47	0 31	0 11	.. ..
28	3 20	3 16	3 12	3 07	3 02	2 57	2 50	2 44	2 36	2 28	2 18	2 06	1 53	1 37
29	4 32	4 30	4 27	4 24	4 21	4 17	4 13	4 09	4 04	3 59	3 53	3 46	3 38	3 29
30	5 46	5 45	5 44	5 42	5 41	5 40	5 38	5 36	5 34	5 32	5 30	5 27	5 24	5 20
31	7 00	7 01	7 01	7 02	7 02	7 03	7 04	7 04	7 05	7 06	7 07	7 09	7 10	7 12
Sept. 1	8 15	8 17	8 19	8 21	8 24	8 27	8 30	8 33	8 37	8 41	8 46	8 51	8 57	9 05
2	9 29	9 33	9 37	9 41	9 46	9 50	9 56	10 02	10 08	10 16	10 24	10 34	10 46	11 00
3	10 43	10 48	10 53	10 59	11 05	11 12	11 20	11 28	11 38	11 49	12 01	12 16	12 34	12 57
4	11 54	12 00	12 06	12 13	12 21	12 30	12 39	12 50	13 02	13 15	13 32	13 52	14 17	14 52
5	12 59	13 06	13 13	13 21	13 29	13 39	13 49	14 01	14 15	14 30	14 49	15 13	15 44	16 34
6	13 58	14 04	14 11	14 19	14 28	14 37	14 48	15 00	15 13	15 29	15 48	16 11	16 42	17 31
7	14 48	14 54	15 01	15 08	15 16	15 24	15 34	15 45	15 57	16 11	16 27	16 47	17 13	17 48
8	15 30	15 35	15 41	15 47	15 54	16 01	16 10	16 18	16 29	16 40	16 53	17 09	17 28	17 51
9	16 06	16 11	16 15	16 20	16 25	16 31	16 37	16 44	16 52	17 01	17 11	17 22	17 36	17 52
10	16 38	16 41	16 44	16 48	16 51	16 56	17 00	17 05	17 10	17 17	17 23	17 31	17 40	17 51

MOONSET

Aug. 16	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
17	7 49	7 49	7 50	7 50	7 51	7 51	7 51	7 52	7 53	7 53	7 54	7 55	7 56	7 57
18	8 47	8 49	8 51	8 52	8 54	8 56	8 59	9 01	9 04	9 07	9 11	9 15	9 19	9 25
19	9 45	9 48	9 51	9 54	9 58	10 02	10 06	10 10	10 15	10 21	10 27	10 35	10 43	10 53
20	10 43	10 47	10 52	10 56	11 01	11 07	11 13	11 19	11 27	11 35	11 44	11 55	12 08	12 24
21	11 42	11 47	11 52	11 58	12 04	12 11	12 19	12 28	12 37	12 48	13 01	13 16	13 34	13 57
22	12 40	12 46	12 52	12 59	13 07	13 15	13 24	13 34	13 46	13 59	14 15	14 34	14 59	15 32
23	13 37	13 43	13 50	13 58	14 06	14 15	14 26	14 37	14 50	15 05	15 24	15 46	16 16	17 01
24	14 31	14 38	14 45	14 53	15 01	15 11	15 21	15 33	15 46	16 02	16 21	16 44	17 16	18 05
25	15 21	15 28	15 34	15 42	15 50	15 59	16 09	16 20	16 32	16 47	17 04	17 25	17 52	18 30
26	16 07	16 12	16 18	16 25	16 32	16 40	16 48	16 58	17 08	17 20	17 34	17 51	18 12	18 38
27	16 47	16 52	16 57	17 02	17 08	17 14	17 20	17 28	17 36	17 45	17 56	18 08	18 22	18 39
28	17 24	17 27	17 31	17 34	17 38	17 43	17 47	17 52	17 58	18 04	18 11	18 19	18 28	18 39
29	17 58	18 00	18 02	18 04	18 06	18 08	18 11	18 13	18 16	18 20	18 24	18 28	18 33	18 38
30	18 30	18 30	18 31	18 31	18 31	18 32	18 32	18 33	18 33	18 34	18 34	18 35	18 36	18 37
31	19 02	19 01	19 00	18 59	18 57	18 55	18 54	18 52	18 50	18 47	18 45	18 42	18 39	18 35
Sept. 1	19 36	19 33	19 31	19 27	19 24	19 21	19 17	19 12	19 08	19 03	18 57	18 50	18 42	18 34
2	20 13	20 09	20 04	20 00	19 55	19 49	19 43	19 36	19 29	19 21	19 11	19 00	18 48	18 33
3	20 54	20 49	20 43	20 37	20 30	20 23	20 15	20 06	19 56	19 44	19 31	19 16	18 57	18 34
4	21 41	21 35	21 28	21 21	21 13	21 04	20 54	20 44	20 31	20 17	20 00	19 40	19 14	18 38
5	22 34	22 27	22 20	22 12	22 04	21 54	21 44	21 32	21 18	21 02	20 43	20 20	19 48	18 58
6	23 32	23 26	23 19	23 11	23 02	22 53	22 43	22 31	22 18	22 02	21 43	21 20	20 49	20 00
7	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 49	23 39	23 27	23 13	22 57	22 38	22 13	21 38
8	0 34	0 28	0 22	0 15	0 07	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 45	23 22
9	1 37	1 32	1 27	1 21	1 15	1 08	1 00	0 51	0 42	0 31	0 18	0 03	.. ..	.. ..
10	2 40	2 36	2 32	2 27	2 23	2 17	2 11	2 05	1 58	1 50	1 41	1 30	1 17	1 02

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	13 26	13 44	13 58	14 10	14 20	14 28	14 43	14 56	15 08	15 21	15 33	15 48	15 57	16 06
9	14 40	14 53	15 03	15 12	15 19	15 26	15 37	15 46	15 55	16 04	16 13	16 24	16 30	16 38
10	15 54	16 01	16 08	16 13	16 17	16 21	16 28	16 34	16 39	16 45	16 51	16 57	17 01	17 06
11	17 05	17 08	17 10	17 12	17 14	17 15	17 18	17 20	17 22	17 24	17 26	17 28	17 30	17 32
12	18 16	18 14	18 12	18 11	18 09	18 08	18 07	18 05	18 03	18 02	18 00	17 59	17 58	17 57
13	19 26	19 19	19 13	19 09	19 05	19 01	18 55	18 50	18 45	18 40	18 35	18 29	18 26	18 22
14	20 36	20 24	20 15	20 07	20 00	19 54	19 44	19 35	19 27	19 19	19 10	19 00	18 55	18 48
15	21 46	21 29	21 16	21 05	20 56	20 47	20 34	20 22	20 10	19 59	19 47	19 34	19 26	19 17
16	22 54	22 33	22 16	22 03	21 51	21 41	21 24	21 09	20 55	20 41	20 27	20 10	20 00	19 49
17	.. ..	23 35	23 16	23 00	22 47	22 35	22 15	21 58	21 42	21 26	21 09	20 50	20 39	20 26
18	0 01	.. ..	.. ..	23 56	23 41	23 29	23 07	22 49	22 31	22 14	21 56	21 35	21 22	21 08
19	1 02	0 34	0 13	.. ..	.. ..	.. ..	23 59	23 40	23 22	23 05	22 46	22 24	22 11	21 57
20	1 56	1 28	1 06	0 48	0 34	0 21	.. ..	.. ..	.. ..	23 57	23 39	23 18	23 06	22 52
21	2 41	2 14	1 54	1 37	1 23	1 11	0 50	0 32	0 15	.. ..	.. ..	.. ..	.. ..	23 53
22	3 17	2 54	2 36	2 21	2 09	1 58	1 39	1 23	1 07	0 52	0 36	0 17	0 06	.. ..
23	3 45	3 27	3 13	3 01	2 51	2 42	2 26	2 13	2 00	1 47	1 34	1 18	1 09	0 59
24	4 08	3 55	3 45	3 37	3 29	3 23	3 12	3 02	2 53	2 44	2 34	2 22	2 16	2 08
25	4 28	4 21	4 15	4 10	4 06	4 03	3 56	3 51	3 45	3 40	3 34	3 28	3 24	3 20
26	4 47	4 45	4 44	4 43	4 42	4 41	4 40	4 39	4 38	4 37	4 36	4 35	4 34	4 33
27	5 05	5 09	5 13	5 16	5 19	5 21	5 25	5 28	5 32	5 35	5 39	5 43	5 46	5 49
28	5 26	5 36	5 44	5 51	5 57	6 02	6 11	6 19	6 27	6 35	6 43	6 53	6 59	7 05
29	5 50	6 06	6 19	6 29	6 38	6 46	7 00	7 13	7 24	7 36	7 49	8 03	8 12	8 22
30	6 20	6 42	6 59	7 13	7 24	7 35	7 53	8 09	8 24	8 38	8 55	9 13	9 24	9 36
Oct. 1	7 00	7 26	7 46	8 02	8 16	8 28	8 49	9 07	9 24	9 41	9 59	10 20	10 32	10 47
2	7 51	8 19	8 40	8 58	9 12	9 25	9 47	10 06	10 23	10 41	11 00	11 22	11 35	11 49

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	4 35	4 15	4 00	3 48	3 37	3 27	3 11	2 57	2 43	2 30	2 15	1 58	1 48	1 37
9	4 57	4 42	4 31	4 21	4 13	4 06	3 53	3 42	3 31	3 21	3 09	2 56	2 49	2 40
10	5 15	5 05	4 57	4 51	4 45	4 40	4 31	4 24	4 17	4 09	4 01	3 52	3 47	3 41
11	5 30	5 25	5 21	5 18	5 15	5 12	5 08	5 04	5 00	4 56	4 52	4 47	4 45	4 41
12	5 44	5 44	5 43	5 43	5 43	5 43	5 42	5 42	5 42	5 42	5 41	5 41	5 41	5 40
13	5 58	6 02	6 05	6 08	6 11	6 13	6 17	6 20	6 23	6 27	6 30	6 34	6 36	6 39
14	6 12	6 21	6 28	6 34	6 39	6 44	6 52	6 59	7 05	7 12	7 19	7 27	7 31	7 37
15	6 28	6 42	6 52	7 01	7 09	7 16	7 28	7 38	7 48	7 57	8 08	8 20	8 27	8 35
16	6 48	7 05	7 20	7 32	7 42	7 50	8 06	8 19	8 32	8 44	8 58	9 13	9 22	9 33
17	7 12	7 34	7 51	8 06	8 18	8 28	8 47	9 03	9 18	9 33	9 49	10 07	10 18	10 31
18	7 42	8 09	8 29	8 45	8 59	9 11	9 31	9 49	10 06	10 22	10 40	11 01	11 13	11 27
19	8 23	8 51	9 13	9 30	9 45	9 58	10 19	10 38	10 56	11 13	11 32	11 54	12 07	12 21
20	9 14	9 43	10 05	10 22	10 37	10 49	11 11	11 30	11 47	12 05	12 23	12 45	12 57	13 12
21	10 18	10 44	11 04	11 20	11 34	11 46	12 06	12 23	12 40	12 56	13 13	13 33	13 45	13 58
22	11 31	11 53	12 10	12 24	12 36	12 46	13 03	13 18	13 33	13 47	14 02	14 19	14 29	14 40
23	12 51	13 08	13 21	13 31	13 41	13 49	14 02	14 14	14 25	14 36	14 48	15 01	15 09	15 18
24	14 16	14 26	14 35	14 42	14 48	14 53	15 02	15 10	15 18	15 25	15 33	15 42	15 47	15 52
25	15 43	15 48	15 52	15 55	15 57	16 00	16 04	16 07	16 10	16 13	16 17	16 20	16 23	16 25
26	17 13	17 11	17 10	17 09	17 08	17 07	17 06	17 05	17 03	17 02	17 01	16 59	16 59	16 58
27	18 44	18 36	18 30	18 25	18 20	18 16	18 09	18 03	17 58	17 52	17 46	17 39	17 36	17 31
28	20 16	20 02	19 51	19 41	19 33	19 26	19 14	19 04	18 54	18 44	18 34	18 22	18 15	18 07
29	21 46	21 26	21 10	20 57	20 46	20 37	20 20	20 06	19 52	19 39	19 25	19 08	18 59	18 48
30	23 11	22 45	22 26	22 10	21 57	21 45	21 25	21 08	20 52	20 36	20 19	19 59	19 48	19 35
Oct. 1	.. ..	23 56	23 34	23 17	23 03	22 50	22 28	22 10	21 52	21 35	21 16	20 54	20 42	20 27
2	0 24	.. ..	.. ..	.. ..	.. ..	23 49	23 27	23 09	22 51	22 34	22 15	21 53	21 40	21 25

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	16 06	16 11	16 15	16 20	16 25	16 31	16 37	16 44	16 52	17 01	17 11	17 22	17 36	17 52
9	16 38	16 41	16 44	16 48	16 51	16 56	17 00	17 05	17 10	17 17	17 23	17 31	17 40	17 51
10	17 06	17 07	17 09	17 12	17 14	17 17	17 19	17 22	17 26	17 29	17 33	17 38	17 43	17 49
11	17 32	17 32	17 33	17 34	17 35	17 36	17 37	17 38	17 39	17 40	17 42	17 43	17 45	17 48
12	17 57	17 56	17 56	17 55	17 54	17 54	17 53	17 52	17 52	17 51	17 50	17 49	17 47	17 46
13	18 22	18 20	18 18	18 17	18 15	18 12	18 10	18 07	18 05	18 01	17 58	17 54	17 49	17 44
14	18 48	18 46	18 43	18 39	18 36	18 32	18 28	18 24	18 19	18 13	18 07	18 00	17 52	17 43
15	19 17	19 13	19 09	19 04	19 00	18 54	18 49	18 42	18 35	18 27	18 18	18 08	17 56	17 42
16	19 49	19 44	19 39	19 33	19 27	19 20	19 13	19 05	18 56	18 45	18 33	18 20	18 03	17 43
17	20 26	20 20	20 14	20 07	20 00	19 52	19 43	19 33	19 22	19 09	18 54	18 37	18 15	17 47
18	21 08	21 02	20 55	20 47	20 39	20 30	20 20	20 09	19 57	19 42	19 25	19 04	18 37	17 58
19	21 57	21 50	21 43	21 35	21 27	21 18	21 07	20 56	20 42	20 27	20 09	19 46	19 16	18 29
20	22 52	22 45	22 39	22 31	22 23	22 14	22 04	21 53	21 40	21 26	21 08	20 47	20 19	19 38
21	23 53	23 47	23 41	23 35	23 27	23 19	23 11	23 01	22 50	22 37	22 22	22 04	21 42	21 13
22	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 58	23 47	23 34	23 18	22 58
23	0 59	0 54	0 49	0 44	0 38	0 32	0 25	0 17	0 08	.. ..	.. ..	.. ..	.. ..	.. ..
24	2 08	2 05	2 01	1 57	1 53	1 49	1 44	1 38	1 32	1 25	1 18	1 09	0 58	0 46
25	3 20	3 18	3 16	3 14	3 12	3 09	3 06	3 03	3 00	2 56	2 52	2 47	2 42	2 35
26	4 33	4 33	4 33	4 32	4 32	4 32	4 31	4 31	4 30	4 29	4 29	4 28	4 27	4 26
27	5 49	5 50	5 51	5 53	5 54	5 56	5 58	6 00	6 02	6 05	6 07	6 11	6 14	6 19
28	7 05	7 08	7 11	7 14	7 18	7 21	7 26	7 30	7 36	7 41	7 48	7 55	8 04	8 14
29	8 22	8 26	8 30	8 36	8 41	8 47	8 53	9 01	9 09	9 18	9 29	9 41	9 56	10 14
30	9 36	9 42	9 48	9 54	10 01	10 09	10 18	10 27	10 38	10 51	11 05	11 23	11 45	12 13
Oct. 1	10 47	10 53	11 00	11 07	11 15	11 24	11 34	11 46	11 59	12 14	12 31	12 53	13 22	14 04
2	11 49	11 56	12 03	12 11	12 19	12 29	12 39	12 51	13 04	13 20	13 39	14 02	14 33	15 21

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	1 37	1 32	1 27	1 21	1 15	1 08	1 00	0 51	0 42	0 31	0 18	0 03	.. ..	.. ..
9	2 40	2 36	2 32	2 27	2 23	2 17	2 11	2 05	1 58	1 50	1 41	1 30	1 17	1 02
10	3 41	3 39	3 36	3 33	3 30	3 26	3 22	3 18	3 13	3 08	3 02	2 55	2 47	2 38
11	4 41	4 40	4 39	4 37	4 35	4 34	4 32	4 29	4 27	4 24	4 21	4 18	4 14	4 09
12	5 40	5 40	5 40	5 40	5 40	5 40	5 40	5 39	5 39	5 39	5 39	5 38	5 38	5 38
13	6 39	6 40	6 41	6 42	6 44	6 45	6 47	6 49	6 51	6 53	6 55	6 58	7 01	7 05
14	7 37	7 39	7 42	7 44	7 47	7 50	7 54	7 58	8 02	8 06	8 12	8 18	8 25	8 33
15	8 35	8 38	8 42	8 46	8 50	8 55	9 00	9 06	9 13	9 20	9 28	9 37	9 49	10 02
16	9 33	9 37	9 42	9 48	9 53	10 00	10 07	10 14	10 23	10 33	10 44	10 57	11 13	11 33
17	10 31	10 36	10 42	10 48	10 55	11 03	11 12	11 21	11 32	11 44	11 59	12 16	12 37	13 05
18	11 27	11 33	11 40	11 47	11 55	12 04	12 14	12 25	12 37	12 51	13 08	13 29	13 56	14 35
19	12 21	12 28	12 35	12 43	12 51	13 00	13 10	13 22	13 35	13 51	14 09	14 32	15 02	15 48
20	13 12	13 18	13 25	13 33	13 41	13 50	14 00	14 11	14 24	14 39	14 57	15 19	15 47	16 28
21	13 58	14 04	14 10	14 17	14 25	14 33	14 42	14 52	15 03	15 17	15 32	15 50	16 13	16 43
22	14 40	14 45	14 50	14 56	15 02	15 09	15 16	15 25	15 34	15 44	15 57	16 11	16 27	16 48
23	15 18	15 21	15 25	15 30	15 35	15 40	15 45	15 51	15 58	16 06	16 14	16 24	16 36	16 49
24	15 52	15 55	15 57	16 00	16 03	16 06	16 10	16 14	16 18	16 23	16 28	16 34	16 41	16 49
25	16 25	16 26	16 27	16 28	16 30	16 31	16 33	16 34	16 36	16 38	16 40	16 43	16 45	16 49
26	16 58	16 57	16 57	16 56	16 56	16 55	16 54	16 54	16 53	16 52	16 51	16 50	16 49	16 48
27	17 31	17 29	17 27	17 25	17 23	17 20	17 17	17 14	17 11	17 07	17 03	16 58	16 53	16 47
28	18 07	18 04	18 00	17 57	17 52	17 48	17 43	17 37	17 31	17 25	17 17	17 08	16 58	16 46
29	18 48	18 43	18 38	18 33	18 27	18 20	18 13	18 05	17 57	17 47	17 35	17 22	17 07	16 48
30	19 35	19 29	19 22	19 16	19 08	19 00	18 51	18 41	18 30	18 17	18 02	17 44	17 21	16 52
Oct. 1	20 27	20 21	20 14	20 06	19 58	19 49	19 38	19 27	19 14	18 59	18 41	18 19	17 50	17 07
2	21 25	21 19	21 12	21 04	20 56	20 46	20 36	20 24	20 11	19 55	19 37	19 13	18 43	17 54

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	7 00	7 26	7 46	8 02	8 16	8 28	8 49	9 07	9 24	9 41	9 59	10 20	10 32	10 47
2	7 51	8 19	8 40	8 58	9 12	9 25	9 47	10 06	10 23	10 41	11 00	11 22	11 35	11 49
3	8 53	9 20	9 41	9 58	10 12	10 24	10 45	11 04	11 21	11 38	11 56	12 17	12 29	12 44
4	10 03	10 27	10 46	11 01	11 13	11 24	11 43	12 00	12 15	12 31	12 47	13 06	13 17	13 29
5	11 17	11 36	11 51	12 04	12 14	12 24	12 39	12 53	13 06	13 19	13 32	13 48	13 57	14 07
6	12 31	12 45	12 57	13 06	13 14	13 21	13 33	13 44	13 53	14 03	14 14	14 25	14 32	14 40
7	13 44	13 53	14 01	14 07	14 12	14 17	14 25	14 32	14 38	14 45	14 51	14 59	15 04	15 09
8	14 56	15 00	15 03	15 06	15 09	15 11	15 14	15 18	15 21	15 24	15 27	15 31	15 33	15 35
9	16 06	16 05	16 05	16 04	16 04	16 04	16 03	16 02	16 02	16 02	16 02	16 01	16 01	16 01
10	17 15	17 10	17 06	17 02	16 59	16 56	16 52	16 48	16 44	16 40	16 36	16 31	16 29	16 26
11	18 25	18 15	18 07	18 00	17 54	17 49	17 40	17 33	17 25	17 18	17 11	17 02	16 58	16 52
12	19 35	19 20	19 08	18 58	18 49	18 42	18 30	18 19	18 08	17 58	17 47	17 35	17 28	17 20
13	20 44	20 24	20 09	19 56	19 45	19 36	19 20	19 06	18 53	18 40	18 26	18 11	18 02	17 51
14	21 51	21 27	21 08	20 53	20 41	20 30	20 11	19 55	19 39	19 24	19 08	18 49	18 39	18 26
15	22 54	22 27	22 06	21 49	21 35	21 23	21 02	20 44	20 28	20 11	19 53	19 32	19 20	19 07
16	23 50	23 21	23 00	22 43	22 28	22 15	21 54	21 35	21 18	21 00	20 41	20 20	20 07	19 53
17	.. ..	.. ..	23 49	23 32	23 17	23 05	22 44	22 26	22 08	21 51	21 33	21 12	20 59	20 45
18	0 37	0 09	.. ..	.. ..	.. ..	23 52	23 33	23 16	23 00	22 44	22 27	22 07	21 56	21 43
19	1 14	0 50	0 32	0 16	0 03	.. ..	.. ..	.. ..	23 51	23 37	23 23	23 06	22 56	22 45
20	1 44	1 25	1 09	0 56	0 45	0 36	0 19	0 05	.. ..	.. ..	.. ..	.. ..	23 59	23 50
21	2 09	1 54	1 42	1 32	1 24	1 17	1 04	0 52	0 42	0 31	0 20	0 07	.. ..	.. ..
22	2 29	2 20	2 12	2 06	2 00	1 55	1 47	1 39	1 32	1 25	1 18	1 09	1 04	0 58
23	2 48	2 44	2 41	2 38	2 35	2 33	2 30	2 26	2 23	2 20	2 17	2 13	2 11	2 09
24	3 06	3 08	3 09	3 10	3 11	3 11	3 13	3 14	3 15	3 16	3 18	3 19	3 20	3 21
25	3 26	3 33	3 38	3 43	3 47	3 51	3 58	4 03	4 09	4 14	4 20	4 27	4 31	4 36

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	.. ..	23 56	23 34	23 17	23 03	22 50	22 28	22 10	21 52	21 35	21 16	20 54	20 42	20 27
2	0 24	.. ..	.. ..	.. ..	.. ..	23 49	23 27	23 09	22 51	22 34	22 15	21 53	21 40	21 25
3	1 22	0 54	0 33	0 16	0 01	.. ..	.. ..	.. ..	23 47	23 31	23 13	22 53	22 41	22 27
4	2 05	1 41	1 21	1 06	0 52	0 41	0 21	0 04	.. ..	.. ..	.. ..	23 53	23 43	23 31
5	2 37	2 17	2 01	1 48	1 36	1 26	1 09	0 54	0 40	0 26	0 11	.. ..	.. ..	.. ..
6	3 02	2 46	2 33	2 23	2 14	2 06	1 52	1 40	1 29	1 18	1 05	0 51	0 43	0 34
7	3 21	3 10	3 01	2 54	2 47	2 42	2 32	2 23	2 15	2 07	1 58	1 48	1 42	1 35
8	3 37	3 31	3 26	3 21	3 18	3 14	3 09	3 04	2 59	2 54	2 49	2 43	2 39	2 36
9	3 51	3 50	3 48	3 47	3 46	3 45	3 44	3 42	3 41	3 40	3 38	3 36	3 35	3 34
10	4 05	4 08	4 10	4 12	4 14	4 15	4 18	4 20	4 22	4 24	4 27	4 29	4 31	4 32
11	4 20	4 27	4 33	4 38	4 42	4 46	4 52	4 58	5 04	5 09	5 15	5 22	5 26	5 30
12	4 36	4 47	4 57	5 05	5 12	5 18	5 28	5 37	5 46	5 55	6 04	6 15	6 21	6 28
13	4 54	5 10	5 23	5 34	5 43	5 52	6 06	6 18	6 30	6 41	6 54	7 08	7 16	7 26
14	5 17	5 37	5 54	6 07	6 19	6 29	6 46	7 01	7 15	7 29	7 44	8 02	8 12	8 24
15	5 46	6 10	6 29	6 45	6 58	7 09	7 29	7 46	8 02	8 19	8 36	8 56	9 07	9 21
16	6 23	6 50	7 11	7 28	7 42	7 55	8 16	8 34	8 52	9 09	9 27	9 48	10 01	10 15
17	7 10	7 38	8 00	8 17	8 32	8 44	9 06	9 25	9 42	9 59	10 18	10 39	10 52	11 06
18	8 08	8 35	8 55	9 12	9 26	9 38	9 59	10 16	10 33	10 50	11 07	11 28	11 40	11 53
19	9 16	9 39	9 57	10 12	10 24	10 35	10 53	11 09	11 24	11 39	11 55	12 13	12 23	12 35
20	10 31	10 49	11 04	11 16	11 26	11 35	11 50	12 03	12 15	12 27	12 40	12 55	13 04	13 13
21	11 50	12 04	12 14	12 23	12 30	12 36	12 47	12 57	13 06	13 15	13 24	13 35	13 41	13 48
22	13 13	13 21	13 27	13 32	13 36	13 39	13 46	13 51	13 56	14 02	14 07	14 13	14 16	14 20
23	14 39	14 40	14 42	14 43	14 44	14 44	14 46	14 47	14 48	14 49	14 50	14 51	14 51	14 52
24	16 07	16 03	15 59	15 56	15 53	15 51	15 47	15 44	15 40	15 37	15 33	15 29	15 27	15 24
25	17 38	17 27	17 19	17 12	17 05	17 00	16 51	16 43	16 35	16 28	16 19	16 10	16 05	15 59

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40	+42	+44	+46	+48	+50	+52	+54	+56	+58	+60	+62	+64	+66
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	10 47	10 53	11 00	11 07	11 15	11 24	11 34	11 46	11 59	12 14	12 31	12 53	13 22	14 04
2	11 49	11 56	12 03	12 11	12 19	12 29	12 39	12 51	13 04	13 20	13 39	14 02	14 33	15 21
3	12 44	12 50	12 57	13 04	13 12	13 21	13 31	13 42	13 54	14 09	14 26	14 46	15 13	15 50
4	13 29	13 35	13 41	13 47	13 54	14 02	14 10	14 20	14 30	14 42	14 56	15 13	15 33	15 59
5	14 07	14 12	14 17	14 22	14 28	14 34	14 41	14 48	14 56	15 06	15 17	15 29	15 44	16 02
6	14 40	14 43	14 47	14 51	14 55	15 00	15 05	15 10	15 16	15 23	15 31	15 40	15 50	16 02
7	15 09	15 11	15 14	15 16	15 19	15 22	15 25	15 29	15 33	15 37	15 42	15 47	15 54	16 01
8	15 35	15 36	15 38	15 39	15 40	15 42	15 43	15 45	15 47	15 49	15 51	15 53	15 56	16 00
9	16 01	16 01	16 01	16 00	16 00	16 00	16 00	16 00	16 00	15 59	15 59	15 59	15 59	15 58
10	16 26	16 25	16 23	16 22	16 20	16 19	16 17	16 15	16 13	16 10	16 07	16 04	16 01	15 57
11	16 52	16 50	16 47	16 44	16 41	16 38	16 35	16 31	16 27	16 22	16 17	16 11	16 04	15 56
12	17 20	17 17	17 13	17 09	17 04	17 00	16 55	16 49	16 43	16 36	16 28	16 19	16 08	15 56
13	17 51	17 47	17 42	17 37	17 31	17 25	17 18	17 10	17 02	16 53	16 42	16 29	16 15	15 57
14	18 26	18 21	18 15	18 09	18 02	17 54	17 46	17 37	17 27	17 15	17 01	16 45	16 25	16 00
15	19 07	19 01	18 54	18 47	18 39	18 31	18 21	18 10	17 58	17 45	17 28	17 09	16 44	16 10
16	19 53	19 46	19 39	19 32	19 24	19 15	19 05	18 53	18 40	18 25	18 07	17 45	17 17	16 34
17	20 45	20 39	20 32	20 24	20 16	20 07	19 57	19 46	19 33	19 18	19 01	18 39	18 11	17 29
18	21 43	21 37	21 31	21 24	21 16	21 08	20 59	20 49	20 37	20 24	20 08	19 49	19 25	18 53
19	22 45	22 40	22 34	22 29	22 22	22 15	22 08	21 59	21 50	21 39	21 26	21 12	20 54	20 31
20	23 50	23 47	23 42	23 38	23 33	23 28	23 22	23 16	23 09	23 01	22 52	22 41	22 29	22 14
21	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 58
22	0 58	0 56	0 53	0 50	0 47	0 44	0 40	0 36	0 31	0 26	0 21	0 14	0 07	.. ..
23	2 09	2 08	2 06	2 05	2 04	2 02	2 01	1 59	1 57	1 55	1 53	1 50	1 47	1 43
24	3 21	3 21	3 22	3 22	3 23	3 24	3 24	3 25	3 26	3 27	3 28	3 29	3 30	3 32
25	4 36	4 38	4 40	4 42	4 44	4 47	4 50	4 53	4 57	5 01	5 06	5 11	5 17	5 24

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	20 27	20 21	20 14	20 06	19 58	19 49	19 38	19 27	19 14	18 59	18 41	18 19	17 50	17 07
2	21 25	21 19	21 12	21 04	20 56	20 46	20 36	20 24	20 11	19 55	19 37	19 13	18 43	17 54
3	22 27	22 21	22 15	22 08	22 00	21 51	21 42	21 31	21 19	21 04	20 48	20 27	20 01	19 24
4	23 31	23 26	23 20	23 14	23 07	23 00	22 52	22 43	22 33	22 21	22 07	21 51	21 32	21 06
5	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 48	23 40	23 30	23 18	23 04	22 47
6	0 34	0 30	0 25	0 20	0 15	0 09	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
7	1 35	1 32	1 29	1 26	1 22	1 18	1 14	1 09	1 04	0 58	0 51	0 43	0 34	0 23
8	2 36	2 34	2 32	2 30	2 28	2 25	2 23	2 20	2 17	2 14	2 10	2 05	2 00	1 54
9	3 34	3 34	3 33	3 33	3 32	3 31	3 31	3 30	3 29	3 28	3 27	3 26	3 24	3 23
10	4 32	4 33	4 34	4 35	4 35	4 36	4 38	4 39	4 40	4 41	4 43	4 45	4 47	4 49
11	5 30	5 32	5 34	5 36	5 39	5 41	5 44	5 47	5 51	5 54	5 59	6 04	6 09	6 16
12	6 28	6 31	6 34	6 38	6 42	6 46	6 51	6 56	7 01	7 08	7 15	7 23	7 33	7 44
13	7 26	7 30	7 35	7 40	7 45	7 51	7 57	8 04	8 12	8 21	8 31	8 43	8 57	9 14
14	8 24	8 29	8 35	8 41	8 47	8 54	9 02	9 11	9 21	9 33	9 46	10 01	10 21	10 45
15	9 21	9 27	9 33	9 40	9 48	9 56	10 05	10 16	10 27	10 41	10 57	11 16	11 41	12 15
16	10 15	10 22	10 29	10 36	10 44	10 53	11 03	11 15	11 27	11 42	12 00	12 22	12 51	13 33
17	11 06	11 13	11 20	11 27	11 36	11 45	11 55	12 06	12 19	12 34	12 52	13 13	13 42	14 24
18	11 53	11 59	12 06	12 13	12 21	12 29	12 38	12 49	13 01	13 14	13 30	13 49	14 14	14 46
19	12 35	12 41	12 46	12 53	12 59	13 06	13 14	13 23	13 33	13 45	13 58	14 13	14 32	14 55
20	13 13	13 18	13 22	13 27	13 32	13 38	13 44	13 51	13 59	14 08	14 18	14 29	14 42	14 58
21	13 48	13 51	13 54	13 58	14 01	14 06	14 10	14 15	14 20	14 26	14 33	14 40	14 49	14 59
22	14 20	14 22	14 24	14 26	14 28	14 30	14 33	14 35	14 38	14 42	14 45	14 49	14 54	14 59
23	14 52	14 52	14 53	14 53	14 53	14 54	14 54	14 55	14 55	14 56	14 56	14 57	14 58	14 59
24	15 24	15 23	15 22	15 21	15 19	15 18	15 16	15 14	15 12	15 10	15 08	15 05	15 02	14 58
25	15 59	15 56	15 54	15 51	15 47	15 44	15 40	15 36	15 31	15 26	15 21	15 14	15 07	14 58

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	3 06	3 08	3 09	3 10	3 11	3 11	3 13	3 14	3 15	3 16	3 18	3 19	3 20	3 21
25	3 26	3 33	3 38	3 43	3 47	3 51	3 58	4 03	4 09	4 14	4 20	4 27	4 31	4 36
26	3 48	4 01	4 11	4 20	4 27	4 34	4 45	4 55	5 05	5 15	5 25	5 37	5 44	5 52
27	4 15	4 34	4 49	5 01	5 12	5 21	5 37	5 51	6 04	6 17	6 32	6 48	6 58	7 09
28	4 51	5 15	5 34	5 49	6 02	6 13	6 32	6 49	7 05	7 21	7 39	7 59	8 10	8 24
29	5 39	6 06	6 27	6 43	6 58	7 10	7 32	7 50	8 07	8 25	8 44	9 05	9 18	9 32
30	6 38	7 06	7 27	7 44	7 59	8 11	8 32	8 51	9 08	9 26	9 44	10 06	10 18	10 33
31	7 48	8 13	8 33	8 48	9 02	9 13	9 33	9 50	10 06	10 22	10 39	10 59	11 10	11 23
Nov. 1	9 03	9 24	9 40	9 54	10 05	10 15	10 31	10 46	11 00	11 13	11 28	11 45	11 54	12 05
2	10 19	10 35	10 47	10 58	11 06	11 14	11 27	11 39	11 50	12 00	12 12	12 25	12 32	12 41
3	11 34	11 44	11 53	12 00	12 06	12 11	12 20	12 28	12 36	12 43	12 51	13 00	13 05	13 11
4	12 46	12 51	12 56	13 00	13 03	13 06	13 11	13 15	13 19	13 23	13 28	13 33	13 36	13 39
5	13 56	13 57	13 58	13 58	13 59	13 59	14 00	14 01	14 01	14 02	14 03	14 03	14 04	14 04
6	15 06	15 02	14 59	14 56	14 54	14 52	14 48	14 45	14 43	14 40	14 37	14 34	14 32	14 30
7	16 15	16 06	15 59	15 53	15 48	15 44	15 37	15 30	15 24	15 18	15 12	15 04	15 00	14 55
8	17 24	17 11	17 00	16 51	16 44	16 37	16 26	16 16	16 06	15 57	15 48	15 36	15 30	15 23
9	18 33	18 15	18 01	17 49	17 39	17 31	17 16	17 03	16 51	16 38	16 26	16 11	16 03	15 53
10	19 42	19 19	19 01	18 47	18 35	18 25	18 07	17 51	17 37	17 22	17 07	16 49	16 39	16 27
11	20 46	20 20	20 00	19 44	19 30	19 19	18 58	18 41	18 25	18 08	17 51	17 31	17 19	17 06
12	21 45	21 17	20 56	20 38	20 24	20 11	19 50	19 32	19 14	18 57	18 39	18 17	18 05	17 51
13	22 34	22 07	21 46	21 29	21 15	21 02	20 41	20 22	20 05	19 48	19 29	19 08	18 56	18 41
14	23 15	22 50	22 31	22 15	22 01	21 50	21 30	21 13	20 56	20 40	20 23	20 03	19 51	19 37
15	23 47	23 26	23 09	22 56	22 44	22 34	22 17	22 01	21 47	21 33	21 17	21 00	20 49	20 38
16	.. ..	23 56	23 43	23 32	23 23	23 15	23 01	22 49	22 37	22 25	22 13	21 59	21 50	21 41
17	0 12	.. ..	.. ..	.. ..	23 59	23 53	23 43	23 34	23 26	23 18	23 09	22 59	22 53	22 46

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	16 07	16 03	15 59	15 56	15 53	15 51	15 47	15 44	15 40	15 37	15 33	15 29	15 27	15 24
25	17 38	17 27	17 19	17 12	17 05	17 00	16 51	16 43	16 35	16 28	16 19	16 10	16 05	15 59
26	19 10	18 53	18 40	18 28	18 19	18 11	17 57	17 44	17 33	17 21	17 09	16 55	16 47	16 38
27	20 40	20 17	19 59	19 45	19 32	19 22	19 04	18 48	18 33	18 18	18 02	17 44	17 34	17 22
28	22 01	21 34	21 13	20 57	20 43	20 31	20 10	19 52	19 35	19 18	19 00	18 39	18 27	18 13
29	23 08	22 40	22 19	22 02	21 47	21 35	21 13	20 54	20 37	20 19	20 00	19 39	19 26	19 11
30	23 59	23 33	23 13	22 57	22 44	22 32	22 11	21 53	21 36	21 19	21 01	20 40	20 28	20 14
31	.. ..	.. ..	23 58	23 44	23 32	23 21	23 03	22 47	22 32	22 17	22 01	21 43	21 32	21 19
Nov. 1	0 37	0 15	.. ..	.. ..	.. ..	.. ..	23 49	23 36	23 24	23 12	22 59	22 43	22 35	22 24
2	1 04	0 47	0 34	0 22	0 13	0 04	.. ..	.. ..	.. ..	.. ..	23 53	23 42	23 35	23 28
3	1 26	1 13	1 04	0 55	0 48	0 42	0 31	0 21	0 12	0 03	.. ..	.. ..	.. ..	.. ..
4	1 43	1 35	1 29	1 24	1 20	1 16	1 09	1 03	0 57	0 51	0 45	0 38	0 34	0 29
5	1 58	1 55	1 53	1 51	1 49	1 47	1 44	1 42	1 40	1 37	1 35	1 32	1 30	1 28
6	2 12	2 14	2 15	2 16	2 17	2 18	2 19	2 20	2 21	2 22	2 23	2 25	2 25	2 26
7	2 27	2 33	2 37	2 41	2 45	2 48	2 53	2 58	3 02	3 07	3 12	3 17	3 20	3 24
8	2 42	2 53	3 01	3 08	3 14	3 19	3 29	3 37	3 44	3 52	4 00	4 10	4 15	4 21
9	3 00	3 15	3 27	3 37	3 45	3 53	4 05	4 17	4 28	4 38	4 50	5 03	5 10	5 19
10	3 21	3 41	3 56	4 08	4 19	4 29	4 45	4 59	5 12	5 26	5 40	5 57	6 06	6 17
11	3 48	4 12	4 30	4 45	4 57	5 08	5 27	5 44	5 59	6 15	6 32	6 51	7 02	7 15
12	4 23	4 50	5 10	5 26	5 40	5 53	6 13	6 31	6 48	7 05	7 23	7 44	7 56	8 10
13	5 08	5 36	5 57	6 14	6 29	6 41	7 03	7 21	7 39	7 56	8 15	8 36	8 49	9 03
14	6 03	6 30	6 51	7 07	7 22	7 34	7 55	8 13	8 30	8 47	9 05	9 25	9 37	9 51
15	7 07	7 32	7 50	8 06	8 19	8 30	8 49	9 05	9 21	9 36	9 52	10 11	10 22	10 34
16	8 19	8 39	8 55	9 08	9 18	9 28	9 44	9 58	10 11	10 24	10 38	10 54	11 03	11 13
17	9 36	9 50	10 02	10 12	10 20	10 27	10 40	10 51	11 01	11 11	11 21	11 33	11 40	11 48

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

59

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	3 21	3 21	3 22	3 22	3 23	3 24	3 24	3 25	3 26	3 27	3 28	3 29	3 30	3 32
25	4 36	4 38	4 40	4 42	4 44	4 47	4 50	4 53	4 57	5 01	5 06	5 11	5 17	5 24
26	5 52	5 56	5 59	6 03	6 08	6 13	6 18	6 24	6 30	6 38	6 46	6 56	7 07	7 21
27	7 09	7 14	7 19	7 25	7 31	7 38	7 46	7 54	8 03	8 14	8 27	8 41	8 59	9 22
28	8 24	8 30	8 36	8 43	8 51	8 59	9 09	9 19	9 31	9 45	10 01	10 21	10 46	11 20
29	9 32	9 39	9 46	9 54	10 02	10 11	10 22	10 33	10 46	11 02	11 20	11 43	12 13	12 59
30	10 33	10 39	10 46	10 54	11 02	11 11	11 21	11 32	11 45	12 00	12 18	12 39	13 08	13 49
31	11 23	11 29	11 35	11 42	11 50	11 58	12 07	12 16	12 28	12 41	12 56	13 14	13 36	14 05
Nov. 1	12 05	12 10	12 15	12 21	12 27	12 34	12 41	12 49	12 58	13 09	13 20	13 34	13 50	14 10
2	12 41	12 44	12 49	12 53	12 58	13 03	13 08	13 14	13 21	13 29	13 37	13 47	13 58	14 12
3	13 11	13 14	13 17	13 20	13 23	13 26	13 30	13 34	13 39	13 44	13 49	13 56	14 03	14 12
4	13 39	13 40	13 42	13 43	13 45	13 47	13 49	13 51	13 54	13 56	13 59	14 03	14 07	14 11
5	14 04	14 05	14 05	14 06	14 06	14 06	14 06	14 07	14 07	14 07	14 08	14 08	14 09	14 10
6	14 30	14 29	14 28	14 27	14 26	14 24	14 23	14 22	14 20	14 18	14 16	14 14	14 12	14 09
7	14 55	14 53	14 51	14 49	14 46	14 44	14 41	14 37	14 34	14 30	14 25	14 20	14 15	14 08
8	15 23	15 20	15 16	15 13	15 09	15 04	15 00	14 55	14 49	14 43	14 36	14 28	14 19	14 08
9	15 53	15 49	15 44	15 39	15 34	15 28	15 22	15 15	15 08	14 59	14 49	14 38	14 24	14 09
10	16 27	16 22	16 16	16 10	16 04	15 57	15 49	15 40	15 31	15 20	15 07	14 52	14 34	14 12
11	17 06	17 00	16 54	16 47	16 39	16 31	16 22	16 12	16 00	15 47	15 32	15 13	14 50	14 19
12	17 51	17 44	17 38	17 30	17 22	17 13	17 03	16 52	16 39	16 25	16 07	15 46	15 18	14 39
13	18 41	18 35	18 28	18 21	18 12	18 03	17 53	17 42	17 29	17 14	16 56	16 35	16 06	15 24
14	19 37	19 31	19 25	19 18	19 10	19 02	18 52	18 42	18 30	18 16	18 00	17 40	17 15	16 41
15	20 38	20 32	20 27	20 21	20 14	20 07	19 59	19 50	19 39	19 28	19 14	18 59	18 39	18 14
16	21 41	21 37	21 32	21 27	21 22	21 16	21 10	21 03	20 55	20 46	20 36	20 24	20 10	19 53
17	22 46	22 43	22 40	22 37	22 33	22 29	22 25	22 20	22 14	22 08	22 01	21 54	21 44	21 34

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	15 24	15 23	15 22	15 21	15 19	15 18	15 16	15 14	15 12	15 10	15 08	15 05	15 02	14 58
25	15 59	15 56	15 54	15 51	15 47	15 44	15 40	15 36	15 31	15 26	15 21	15 14	15 07	14 58
26	16 38	16 34	16 29	16 25	16 20	16 14	16 08	16 02	15 54	15 46	15 37	15 26	15 14	14 59
27	17 22	17 17	17 11	17 05	16 58	16 51	16 43	16 34	16 24	16 13	15 59	15 44	15 26	15 02
28	18 13	18 07	18 00	17 53	17 45	17 36	17 27	17 16	17 04	16 50	16 33	16 13	15 48	15 12
29	19 11	19 05	18 57	18 50	18 41	18 32	18 22	18 10	17 57	17 41	17 23	17 00	16 30	15 44
30	20 14	20 08	20 01	19 54	19 46	19 37	19 27	19 16	19 03	18 48	18 31	18 09	17 41	17 00
31	21 19	21 14	21 08	21 01	20 54	20 46	20 38	20 28	20 17	20 05	19 50	19 33	19 11	18 42
Nov. 1	22 24	22 20	22 15	22 10	22 04	21 58	21 51	21 43	21 35	21 25	21 14	21 01	20 46	20 26
2	23 28	23 24	23 21	23 17	23 13	23 08	23 03	22 58	22 52	22 45	22 37	22 28	22 18	22 05
3	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 52	23 46	23 39
4	0 29	0 27	0 24	0 22	0 19	0 17	0 14	0 10	0 06	0 02	.. ..	.. ..	.. ..	.. ..
5	1 28	1 27	1 26	1 25	1 24	1 23	1 22	1 20	1 19	1 17	1 15	1 13	1 11	1 08
6	2 26	2 26	2 27	2 27	2 28	2 28	2 29	2 29	2 30	2 31	2 31	2 32	2 33	2 34
7	3 24	3 25	3 27	3 29	3 31	3 33	3 35	3 38	3 40	3 43	3 47	3 51	3 55	4 01
8	4 21	4 24	4 27	4 30	4 34	4 37	4 41	4 46	4 51	4 56	5 02	5 10	5 18	5 28
9	5 19	5 23	5 27	5 32	5 37	5 42	5 48	5 54	6 01	6 09	6 18	6 29	6 41	6 56
10	6 17	6 22	6 27	6 33	6 39	6 46	6 53	7 02	7 11	7 22	7 34	7 48	8 06	8 27
11	7 15	7 20	7 27	7 33	7 41	7 49	7 57	8 07	8 19	8 31	8 47	9 05	9 27	9 58
12	8 10	8 17	8 24	8 31	8 39	8 48	8 58	9 09	9 21	9 36	9 53	10 14	10 41	11 21
13	9 03	9 09	9 16	9 24	9 32	9 41	9 51	10 03	10 16	10 30	10 48	11 10	11 39	12 21
14	9 51	9 57	10 04	10 11	10 19	10 28	10 37	10 48	11 00	11 14	11 31	11 51	12 16	12 51
15	10 34	10 40	10 46	10 52	10 59	11 07	11 15	11 25	11 35	11 47	12 01	12 18	12 38	13 03
16	11 13	11 18	11 23	11 28	11 34	11 40	11 47	11 54	12 03	12 12	12 23	12 35	12 50	13 08
17	11 48	11 51	11 55	11 59	12 03	12 08	12 13	12 18	12 25	12 31	12 39	12 48	12 58	13 10

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	.. ..	23 56	23 43	23 32	23 23	23 15	23 01	22 49	22 37	22 25	22 13	21 59	21 50	21 41
17	0 12	.. ..	.. ..	.. ..	23 59	23 53	23 43	23 34	23 26	23 18	23 09	22 59	22 53	22 46
18	0 34	0 22	0 13	0 06	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 53
19	0 52	0 46	0 41	0 37	0 33	0 30	0 25	0 20	0 15	0 10	0 06	0 00	.. ..	.. ..
20	1 10	1 09	1 08	1 07	1 07	1 06	1 06	1 05	1 04	1 04	1 03	1 02	1 02	1 02
21	1 28	1 32	1 36	1 39	1 41	1 44	1 48	1 52	1 55	1 59	2 02	2 07	2 09	2 12
22	1 48	1 58	2 06	2 12	2 18	2 23	2 32	2 41	2 48	2 56	3 04	3 13	3 19	3 25
23	2 12	2 27	2 40	2 50	2 59	3 07	3 21	3 33	3 44	3 56	4 08	4 22	4 31	4 40
24	2 42	3 03	3 20	3 34	3 46	3 56	4 14	4 29	4 44	4 58	5 14	5 32	5 43	5 55
25	3 23	3 49	4 09	4 25	4 39	4 51	5 11	5 29	5 46	6 02	6 21	6 41	6 54	7 08
26	4 17	4 45	5 06	5 23	5 38	5 51	6 12	6 31	6 48	7 06	7 25	7 46	7 59	8 14
27	5 24	5 51	6 11	6 28	6 42	6 54	7 15	7 32	7 49	8 06	8 24	8 45	8 57	9 10
28	6 40	7 03	7 21	7 35	7 47	7 58	8 16	8 32	8 47	9 02	9 17	9 35	9 46	9 58
29	7 58	8 16	8 30	8 42	8 52	9 00	9 15	9 28	9 40	9 52	10 05	10 19	10 28	10 37
30	9 16	9 28	9 38	9 47	9 54	10 00	10 11	10 20	10 29	10 38	10 47	10 58	11 04	11 11
Dec. 1	10 31	10 38	10 44	10 49	10 53	10 57	11 04	11 09	11 15	11 20	11 26	11 32	11 36	11 40
2	11 43	11 45	11 47	11 49	11 51	11 52	11 54	11 56	11 58	12 00	12 02	12 04	12 06	12 07
3	12 53	12 51	12 49	12 48	12 46	12 45	12 43	12 42	12 40	12 38	12 37	12 35	12 34	12 33
4	14 03	13 56	13 50	13 45	13 41	13 38	13 32	13 26	13 21	13 16	13 11	13 05	13 02	12 58
5	15 12	15 00	14 51	14 43	14 36	14 31	14 20	14 12	14 03	13 55	13 47	13 37	13 31	13 25
6	16 21	16 05	15 52	15 41	15 32	15 24	15 10	14 58	14 47	14 36	14 24	14 11	14 03	13 54
7	17 30	17 09	16 52	16 39	16 28	16 18	16 01	15 46	15 32	15 18	15 04	14 47	14 38	14 27
8	18 36	18 11	17 52	17 37	17 23	17 12	16 52	16 35	16 20	16 04	15 47	15 28	15 17	15 04
9	19 38	19 10	18 49	18 32	18 18	18 06	17 45	17 26	17 09	16 52	16 34	16 13	16 01	15 47
10	20 31	20 03	19 42	19 25	19 10	18 58	18 36	18 18	18 00	17 43	17 24	17 03	16 50	16 36

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	8 19	8 39	8 55	9 08	9 18	9 28	9 44	9 58	10 11	10 24	10 38	10 54	11 03	11 13
17	9 36	9 50	10 02	10 12	10 20	10 27	10 40	10 51	11 01	11 11	11 21	11 33	11 40	11 48
18	10 55	11 04	11 12	11 18	11 23	11 28	11 36	11 43	11 49	11 56	12 03	12 11	12 15	12 20
19	12 16	12 20	12 23	12 26	12 28	12 30	12 33	12 36	12 38	12 41	12 44	12 47	12 49	12 51
20	13 40	13 38	13 36	13 35	13 34	13 33	13 31	13 30	13 28	13 27	13 25	13 23	13 22	13 21
21	15 06	14 58	14 52	14 47	14 42	14 38	14 31	14 25	14 20	14 14	14 08	14 02	13 58	13 53
22	16 35	16 21	16 10	16 01	15 53	15 46	15 34	15 24	15 14	15 05	14 55	14 43	14 36	14 29
23	18 04	17 44	17 29	17 16	17 05	16 56	16 39	16 25	16 12	15 59	15 45	15 29	15 20	15 09
24	19 30	19 05	18 46	18 30	18 17	18 05	17 46	17 29	17 13	16 57	16 40	16 21	16 09	15 56
25	20 45	20 18	19 57	19 40	19 25	19 13	18 51	18 33	18 15	17 58	17 40	17 18	17 06	16 51
26	21 46	21 19	20 58	20 41	20 27	20 15	19 53	19 35	19 18	19 00	18 42	18 20	18 08	17 53
27	22 31	22 07	21 49	21 34	21 21	21 09	20 50	20 33	20 17	20 01	19 44	19 24	19 13	18 59
28	23 04	22 45	22 30	22 17	22 06	21 57	21 41	21 26	21 13	20 59	20 45	20 28	20 18	20 07
29	23 29	23 14	23 03	22 53	22 45	22 38	22 26	22 14	22 04	21 54	21 42	21 29	21 22	21 13
30	23 48	23 39	23 31	23 25	23 19	23 14	23 06	22 58	22 51	22 44	22 37	22 28	22 23	22 17
Dec. 1	.. ..	.. ..	23 56	23 53	23 50	23 48	23 43	23 39	23 36	23 32	23 28	23 24	23 21	23 18
2	0 04	0 00	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
3	0 19	0 19	0 19	0 19	0 19	0 19	0 19	0 18	0 18	0 18	0 18	0 18	0 18	0 18
4	0 33	0 38	0 41	0 44	0 47	0 49	0 53	0 57	1 00	1 03	1 07	1 11	1 13	1 16
5	0 48	0 57	1 04	1 10	1 16	1 20	1 28	1 35	1 42	1 48	1 55	2 03	2 08	2 13
6	1 05	1 19	1 29	1 38	1 46	1 53	2 04	2 15	2 24	2 34	2 44	2 56	3 03	3 11
7	1 25	1 43	1 57	2 09	2 19	2 28	2 43	2 56	3 08	3 21	3 34	3 50	3 59	4 09
8	1 50	2 12	2 29	2 44	2 56	3 06	3 24	3 40	3 55	4 10	4 26	4 44	4 55	5 07
9	2 22	2 48	3 07	3 23	3 37	3 49	4 09	4 27	4 43	5 00	5 18	5 38	5 50	6 04
10	3 03	3 31	3 52	4 09	4 24	4 36	4 58	5 16	5 34	5 51	6 10	6 31	6 43	6 58

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011

61

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40	+42	+44	+46	+48	+50	+52	+54	+56	+58	+60	+62	+64	+66
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	21 41	21 37	21 32	21 27	21 22	21 16	21 10	21 03	20 55	20 46	20 36	20 24	20 10	19 53
17	22 46	22 43	22 40	22 37	22 33	22 29	22 25	22 20	22 14	22 08	22 01	21 54	21 44	21 34
18	23 53	23 51	23 50	23 48	23 46	23 44	23 41	23 39	23 36	23 33	23 29	23 25	23 20	23 15
19	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
20	1 02	1 01	1 01	1 01	1 01	1 01	1 00	1 00	1 00	0 59	0 59	0 58	0 58	0 57
21	2 12	2 14	2 15	2 16	2 18	2 20	2 22	2 24	2 26	2 29	2 31	2 35	2 38	2 43
22	3 25	3 28	3 31	3 34	3 38	3 41	3 46	3 50	3 55	4 01	4 07	4 15	4 23	4 33
23	4 40	4 44	4 49	4 54	4 59	5 05	5 11	5 18	5 26	5 35	5 46	5 58	6 12	6 29
24	5 55	6 01	6 07	6 13	6 20	6 28	6 36	6 46	6 56	7 09	7 23	7 40	8 01	8 29
25	7 08	7 14	7 21	7 28	7 36	7 45	7 55	8 06	8 19	8 34	8 51	9 13	9 41	10 21
26	8 14	8 20	8 27	8 35	8 43	8 53	9 03	9 14	9 28	9 43	10 01	10 24	10 54	11 39
27	9 10	9 17	9 23	9 31	9 38	9 47	9 57	10 07	10 19	10 33	10 50	11 10	11 35	12 09
28	9 58	10 03	10 09	10 15	10 22	10 29	10 37	10 46	10 56	11 08	11 21	11 37	11 55	12 19
29	10 37	10 42	10 46	10 51	10 56	11 02	11 08	11 15	11 23	11 32	11 42	11 53	12 06	12 22
30	11 11	11 14	11 17	11 21	11 25	11 29	11 33	11 38	11 43	11 49	11 56	12 04	12 13	12 23
Dec. 1	11 40	11 42	11 44	11 46	11 48	11 51	11 54	11 56	12 00	12 03	12 07	12 12	12 17	12 23
2	12 07	12 08	12 08	12 09	12 10	12 11	12 12	12 13	12 14	12 15	12 16	12 18	12 20	12 22
3	12 33	12 32	12 31	12 31	12 30	12 30	12 29	12 28	12 27	12 26	12 25	12 24	12 22	12 21
4	12 58	12 57	12 55	12 53	12 51	12 49	12 46	12 44	12 41	12 37	12 34	12 30	12 25	12 20
5	13 25	13 22	13 19	13 16	13 13	13 09	13 05	13 00	12 55	12 50	12 44	12 37	12 29	12 20
6	13 54	13 50	13 46	13 42	13 37	13 32	13 26	13 20	13 13	13 05	12 56	12 46	12 34	12 20
7	14 27	14 22	14 17	14 11	14 05	13 58	13 51	13 43	13 34	13 24	13 12	12 58	12 42	12 22
8	15 04	14 58	14 52	14 45	14 38	14 30	14 22	14 12	14 01	13 49	13 34	13 17	12 55	12 28
9	15 47	15 41	15 34	15 27	15 19	15 10	15 00	14 49	14 37	14 23	14 06	13 45	13 19	12 42
10	16 36	16 30	16 23	16 15	16 07	15 58	15 48	15 36	15 23	15 08	14 51	14 29	14 00	13 18

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	11 13	11 18	11 23	11 28	11 34	11 40	11 47	11 54	12 03	12 12	12 23	12 35	12 50	13 08
17	11 48	11 51	11 55	11 59	12 03	12 08	12 13	12 18	12 25	12 31	12 39	12 48	12 58	13 10
18	12 20	12 22	12 25	12 27	12 30	12 33	12 36	12 39	12 43	12 47	12 52	12 57	13 03	13 10
19	12 51	12 51	12 52	12 53	12 54	12 56	12 57	12 58	13 00	13 01	13 03	13 05	13 07	13 10
20	13 21	13 21	13 20	13 20	13 19	13 18	13 17	13 16	13 15	13 14	13 13	13 11	13 10	13 10
21	13 53	13 51	13 49	13 47	13 45	13 42	13 40	13 37	13 33	13 29	13 25	13 21	13 15	13 09
22	14 29	14 25	14 22	14 18	14 14	14 09	14 05	13 59	13 53	13 47	13 39	13 31	13 21	13 10
23	15 09	15 04	14 59	14 54	14 48	14 42	14 35	14 27	14 19	14 09	13 58	13 45	13 30	13 11
24	15 56	15 51	15 44	15 38	15 30	15 22	15 13	15 04	14 53	14 40	14 25	14 07	13 46	13 17
25	16 51	16 45	16 38	16 30	16 22	16 13	16 03	15 52	15 39	15 24	15 06	14 44	14 16	13 36
26	17 53	17 47	17 40	17 32	17 24	17 14	17 04	16 53	16 40	16 24	16 06	15 43	15 14	14 29
27	18 59	18 53	18 47	18 40	18 32	18 24	18 15	18 04	17 52	17 39	17 23	17 03	16 38	16 04
28	20 07	20 02	19 57	19 51	19 44	19 37	19 30	19 21	19 12	19 01	18 48	18 33	18 15	17 52
29	21 13	21 09	21 05	21 01	20 56	20 51	20 45	20 39	20 32	20 24	20 15	20 04	19 52	19 37
30	22 17	22 14	22 12	22 09	22 06	22 02	21 58	21 54	21 49	21 44	21 38	21 32	21 24	21 15
Dec. 1	23 18	23 17	23 16	23 14	23 12	23 11	23 09	23 07	23 04	23 02	22 59	22 56	22 52	22 47
2	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
3	0 18	0 17	0 17	0 17	0 17	0 17	0 17	0 17	0 17	0 17	0 17	0 16	0 16	0 16
4	1 16	1 17	1 18	1 19	1 21	1 22	1 24	1 26	1 28	1 30	1 33	1 35	1 39	1 43
5	2 13	2 16	2 18	2 21	2 24	2 27	2 30	2 34	2 38	2 43	2 48	2 54	3 01	3 09
6	3 11	3 14	3 18	3 22	3 27	3 31	3 36	3 42	3 49	3 56	4 04	4 13	4 24	4 37
7	4 09	4 13	4 18	4 24	4 29	4 36	4 42	4 50	4 59	5 08	5 19	5 33	5 48	6 07
8	5 07	5 12	5 18	5 24	5 31	5 39	5 47	5 57	6 07	6 19	6 34	6 51	7 11	7 38
9	6 04	6 10	6 16	6 23	6 31	6 40	6 49	7 00	7 12	7 26	7 43	8 03	8 29	9 06
10	6 58	7 04	7 11	7 19	7 27	7 36	7 46	7 57	8 10	8 25	8 43	9 05	9 34	10 16

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2011
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	19 38	19 10	18 49	18 32	18 18	18 06	17 45	17 26	17 09	16 52	16 34	16 13	16 01	15 47
10	20 31	20 03	19 42	19 25	19 10	18 58	18 36	18 18	18 00	17 43	17 24	17 03	16 50	16 36
11	21 15	20 49	20 29	20 13	19 59	19 47	19 27	19 09	18 52	18 35	18 18	17 57	17 45	17 31
12	21 50	21 28	21 10	20 56	20 44	20 33	20 15	19 59	19 44	19 29	19 13	18 54	18 43	18 31
13	22 18	22 00	21 46	21 34	21 24	21 15	21 00	20 47	20 34	20 22	20 09	19 53	19 44	19 34
14	22 40	22 27	22 17	22 08	22 01	21 55	21 43	21 33	21 24	21 15	21 05	20 53	20 47	20 39
15	22 59	22 51	22 45	22 40	22 35	22 31	22 24	22 18	22 13	22 07	22 01	21 54	21 50	21 45
16	23 16	23 14	23 12	23 10	23 08	23 07	23 05	23 03	23 01	22 59	22 57	22 55	22 53	22 52
17	23 34	23 36	23 38	23 40	23 42	23 43	23 45	23 48	23 50	23 52	23 54	23 57	23 58	.. ..
18	23 52	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 00
19	.. ..	0 00	0 06	0 11	0 16	0 20	0 27	0 34	0 40	0 46	0 52	1 00	1 04	1 09
20	0 13	0 26	0 37	0 46	0 54	1 00	1 12	1 23	1 32	1 42	1 53	2 05	2 12	2 21
21	0 39	0 58	1 13	1 25	1 36	1 45	2 01	2 15	2 28	2 42	2 56	3 12	3 22	3 33
22	1 14	1 37	1 56	2 11	2 24	2 35	2 54	3 11	3 27	3 43	4 00	4 20	4 32	4 45
23	2 00	2 27	2 48	3 05	3 19	3 31	3 52	4 11	4 28	4 46	5 04	5 26	5 38	5 53
24	3 00	3 27	3 49	4 06	4 20	4 32	4 54	5 12	5 30	5 47	6 06	6 27	6 39	6 54
25	4 12	4 37	4 56	5 12	5 25	5 36	5 56	6 13	6 29	6 45	7 02	7 22	7 33	7 46
26	5 30	5 51	6 07	6 20	6 31	6 41	6 57	7 12	7 25	7 39	7 53	8 10	8 19	8 30
27	6 50	7 05	7 17	7 27	7 36	7 43	7 56	8 07	8 18	8 28	8 39	8 52	8 59	9 07
28	8 08	8 18	8 26	8 32	8 38	8 43	8 52	8 59	9 06	9 13	9 20	9 29	9 34	9 39
29	9 23	9 28	9 32	9 35	9 38	9 40	9 44	9 48	9 51	9 55	9 59	10 03	10 05	10 08
30	10 36	10 36	10 36	10 35	10 35	10 35	10 35	10 35	10 35	10 35	10 35	10 34	10 34	10 34
31	11 47	11 42	11 38	11 34	11 31	11 29	11 24	11 21	11 17	11 13	11 10	11 05	11 03	11 00
32	12 57	12 47	12 39	12 32	12 27	12 22	12 13	12 06	11 59	11 52	11 45	11 37	11 32	11 27
33	14 06	13 51	13 40	13 30	13 22	13 15	13 03	12 52	12 42	12 32	12 21	12 09	12 03	11 55

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	2 22	2 48	3 07	3 23	3 37	3 49	4 09	4 27	4 43	5 00	5 18	5 38	5 50	6 04
10	3 03	3 31	3 52	4 09	4 24	4 36	4 58	5 16	5 34	5 51	6 10	6 31	6 43	6 58
11	3 56	4 23	4 44	5 02	5 16	5 28	5 50	6 08	6 25	6 42	7 01	7 22	7 34	7 48
12	4 58	5 24	5 43	5 59	6 12	6 24	6 44	7 01	7 17	7 33	7 50	8 09	8 21	8 34
13	6 09	6 31	6 47	7 01	7 12	7 22	7 39	7 54	8 08	8 22	8 37	8 53	9 03	9 14
14	7 25	7 41	7 54	8 05	8 14	8 22	8 36	8 47	8 58	9 09	9 21	9 34	9 42	9 50
15	8 43	8 54	9 03	9 10	9 17	9 22	9 32	9 40	9 47	9 55	10 03	10 12	10 17	10 23
16	10 03	10 09	10 13	10 17	10 20	10 23	10 28	10 32	10 36	10 39	10 43	10 48	10 51	10 54
17	11 24	11 24	11 24	11 24	11 24	11 24	11 24	11 24	11 24	11 24	11 24	11 24	11 23	11 23
18	12 47	12 41	12 36	12 33	12 29	12 27	12 22	12 17	12 13	12 09	12 05	12 00	11 57	11 54
19	14 11	14 00	13 51	13 43	13 37	13 31	13 21	13 12	13 04	12 56	12 48	12 38	12 33	12 26
20	15 37	15 20	15 06	14 55	14 45	14 37	14 23	14 10	13 59	13 47	13 35	13 20	13 12	13 03
21	17 02	16 39	16 22	16 07	15 55	15 45	15 26	15 11	14 56	14 41	14 26	14 08	13 57	13 45
22	18 21	17 54	17 34	17 18	17 04	16 51	16 31	16 13	15 56	15 39	15 21	15 01	14 49	14 35
23	19 28	19 01	18 40	18 22	18 08	17 55	17 34	17 15	16 58	16 40	16 21	16 00	15 47	15 32
24	20 21	19 55	19 36	19 19	19 06	18 54	18 33	18 15	17 58	17 42	17 23	17 03	16 50	16 36
25	21 00	20 39	20 22	20 08	19 56	19 45	19 27	19 11	18 57	18 42	18 26	18 07	17 56	17 44
26	21 29	21 12	20 59	20 48	20 39	20 30	20 16	20 03	19 51	19 39	19 26	19 11	19 02	18 52
27	21 51	21 40	21 30	21 22	21 16	21 10	20 59	20 50	20 41	20 32	20 23	20 12	20 06	19 59
28	22 10	22 03	21 57	21 53	21 49	21 45	21 39	21 33	21 28	21 23	21 17	21 11	21 07	21 03
29	22 25	22 23	22 22	22 20	22 19	22 18	22 16	22 14	22 12	22 11	22 09	22 07	22 06	22 04
30	22 40	22 43	22 45	22 46	22 48	22 49	22 51	22 53	22 55	22 57	22 59	23 01	23 02	23 04
31	22 55	23 02	23 08	23 12	23 16	23 20	23 26	23 32	23 37	23 42	23 48	23 54	23 58	.. ..
32	23 11	23 22	23 32	23 39	23 46	23 52	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 02
33	23 30	23 46	23 58	.. ..	.. ..	.. ..	0 02	0 11	0 20	0 28	0 37	0 47	0 53	1 00

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	15 47	15 41	15 34	15 27	15 19	15 10	15 00	14 49	14 37	14 23	14 06	13 45	13 19	12 42
10	16 36	16 30	16 23	16 15	16 07	15 58	15 48	15 36	15 23	15 08	14 51	14 29	14 00	13 18
11	17 31	17 25	17 18	17 11	17 03	16 54	16 45	16 34	16 22	16 07	15 50	15 30	15 03	14 26
12	18 31	18 25	18 19	18 13	18 06	17 58	17 50	17 40	17 29	17 17	17 03	16 46	16 24	15 56
13	19 34	19 29	19 25	19 19	19 14	19 07	19 00	18 53	18 44	18 35	18 23	18 10	17 55	17 36
14	20 39	20 36	20 32	20 28	20 24	20 19	20 14	20 09	20 03	19 56	19 48	19 39	19 29	19 16
15	21 45	21 43	21 41	21 38	21 36	21 33	21 30	21 27	21 23	21 19	21 15	21 09	21 03	20 56
16	22 52	22 51	22 50	22 50	22 49	22 48	22 47	22 46	22 45	22 44	22 42	22 41	22 39	22 36
17	...	...	...	...	...	...	...	...	...	...	...	...	...	...
18	0 00	0 01	0 01	0 02	0 03	0 04	0 05	0 07	0 08	0 09	0 11	0 13	0 15	0 18
19	1 09	1 12	1 14	1 16	1 19	1 22	1 25	1 29	1 33	1 37	1 42	1 48	1 55	2 02
20	2 21	2 24	2 28	2 32	2 37	2 42	2 47	2 53	3 00	3 08	3 16	3 26	3 38	3 52
21	3 33	3 38	3 43	3 49	3 55	4 02	4 10	4 18	4 28	4 38	4 51	5 05	5 23	5 46
22	4 45	4 51	4 57	5 04	5 12	5 20	5 30	5 40	5 52	6 05	6 21	6 41	7 06	7 40
23	5 53	5 59	6 06	6 14	6 22	6 32	6 42	6 53	7 06	7 22	7 40	8 03	8 32	9 17
24	6 54	7 00	7 07	7 15	7 23	7 32	7 42	7 53	8 06	8 21	8 39	9 01	9 29	10 10
25	7 46	7 52	7 58	8 05	8 13	8 21	8 29	8 39	8 51	9 04	9 19	9 36	9 59	10 27
26	8 30	8 35	8 40	8 46	8 52	8 59	9 06	9 14	9 23	9 33	9 44	9 58	10 14	10 33
27	9 07	9 11	9 15	9 19	9 24	9 29	9 34	9 40	9 46	9 54	10 02	10 11	10 22	10 35
28	9 39	9 42	9 44	9 47	9 50	9 53	9 57	10 01	10 05	10 09	10 15	10 21	10 27	10 35
29	10 08	10 09	10 10	10 12	10 13	10 15	10 16	10 18	10 20	10 22	10 25	10 28	10 31	10 35
30	10 34	10 34	10 34	10 34	10 34	10 34	10 34	10 34	10 34	10 34	10 34	10 34	10 34	10 34
31	11 00	10 59	10 58	10 56	10 55	10 53	10 52	10 50	10 48	10 45	10 43	10 40	10 37	10 33
32	11 27	11 24	11 22	11 19	11 16	11 13	11 10	11 06	11 02	10 58	10 52	10 47	10 40	10 33
33	11 55	11 51	11 48	11 44	11 39	11 35	11 30	11 24	11 18	11 11	11 04	10 55	10 45	10 33

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	6 04	6 10	6 16	6 23	6 31	6 40	6 49	7 00	7 12	7 26	7 43	8 03	8 29	9 06
10	6 58	7 04	7 11	7 19	7 27	7 36	7 46	7 57	8 10	8 25	8 43	9 05	9 34	10 16
11	7 48	7 55	8 01	8 09	8 17	8 26	8 35	8 46	8 59	9 13	9 30	9 51	10 18	10 56
12	8 34	8 39	8 46	8 52	9 00	9 08	9 16	9 26	9 37	9 50	10 05	10 22	10 44	11 13
13	9 14	9 19	9 24	9 30	9 36	9 43	9 50	9 58	10 07	10 18	10 29	10 43	10 59	11 19
14	9 50	9 54	9 58	10 03	10 07	10 12	10 18	10 24	10 31	10 38	10 47	10 57	11 08	11 22
15	10 23	10 26	10 28	10 31	10 34	10 38	10 42	10 46	10 50	10 55	11 01	11 07	11 14	11 23
16	10 54	10 55	10 56	10 58	10 59	11 01	11 03	11 05	11 07	11 09	11 12	11 15	11 19	11 23
17	11 23	11 23	11 23	11 23	11 23	11 23	11 23	11 23	11 23	11 23	11 23	11 23	11 22	11 22
18	11 54	11 52	11 51	11 49	11 48	11 46	11 44	11 42	11 39	11 36	11 33	11 30	11 26	11 22
19	12 26	12 24	12 21	12 18	12 14	12 10	12 06	12 02	11 57	11 52	11 46	11 39	11 31	11 22
20	13 03	12 59	12 54	12 50	12 45	12 39	12 33	12 26	12 19	12 11	12 01	11 50	11 38	11 23
21	13 45	13 40	13 34	13 28	13 21	13 14	13 06	12 57	12 47	12 36	12 23	12 08	11 49	11 26
22	14 35	14 29	14 22	14 15	14 07	13 58	13 49	13 38	13 26	13 12	12 56	12 36	12 11	11 36
23	15 32	15 26	15 19	15 11	15 03	14 53	14 43	14 31	14 18	14 03	13 45	13 22	12 52	12 07
24	16 36	16 30	16 23	16 16	16 08	15 59	15 49	15 38	15 25	15 10	14 53	14 31	14 03	13 23
25	17 44	17 38	17 32	17 26	17 19	17 11	17 03	16 53	16 42	16 30	16 15	15 58	15 36	15 08
26	18 52	18 48	18 43	18 38	18 32	18 26	18 19	18 12	18 04	17 54	17 43	17 30	17 15	16 57
27	19 59	19 56	19 52	19 48	19 44	19 40	19 35	19 30	19 24	19 18	19 10	19 02	18 52	18 40
28	21 03	21 01	20 59	20 57	20 54	20 52	20 49	20 46	20 43	20 39	20 35	20 30	20 24	20 18
29	22 04	22 04	22 03	22 02	22 02	22 01	22 00	21 59	21 58	21 57	21 55	21 54	21 52	21 50
30	23 04	23 05	23 05	23 06	23 07	23 08	23 09	23 10	23 11	23 12	23 13	23 15	23 17	23 19
31	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32	0 02	0 04	0 06	0 08	0 11	0 13	0 16	0 19	0 22	0 26	0 30	0 35	0 40	0 46
33	1 00	1 03	1 07	1 10	1 14	1 18	1 22	1 27	1 33	1 39	1 46	1 54	2 03	2 14

... .. indicates phenomenon will occur the next day.

CONTENTS OF THE ECLIPSE SECTION

Explanatory Text	65
Solar Eclipses	65
Lunar Eclipses	68
January 4: Partial Solar Eclipse	
Circumstances	70
Eclipse Map	71
June 1: Partial Solar Eclipse	
Circumstances	72
Eclipse Map	73
June 15: Total Lunar Eclipse	74
July 1: Partial Solar Eclipse	
Circumstances	75
Eclipse Map	76
November 25: Partial Solar Eclipse	
Circumstances	77
Eclipse Map	78
December 10: Total Lunar Eclipse	79

SUMMARY OF ECLIPSES AND TRANSITS FOR 2011

There are four eclipses of the Sun and two of the Moon in 2011. All times are expressed in Universal Time using $\Delta T = +67^{\text{s}}.0$. There are no transits of Mercury or Venus across the Sun in 2011.

I. *A partial eclipse of the Sun*, January 4. See map on page 71. The eclipse begins at 06^h 40^m and ends at 11^h 01^m. It is visible from Europe, northern Africa, the Middle East, and western Asia.

II. *A partial eclipse of the Sun*, June 1. See map on page 73. The eclipse begins at 19^h 25^m and ends at 23^h 07^m. It is visible from eastern Asia, northern North America, Greenland, and the Arctic Ocean.

III. *A total eclipse of the Moon*, June 15. See map on page 74. The eclipse begins at 17^h 23^m and ends at 23^h 02^m; the total phase begins at 19^h 22^m and ends at 21^h 03^m. It is visible from South America, Africa, Europe, the Middle East, Asia, Australia, Antarctica, and the Atlantic, Indian, and southwestern Pacific Ocean.

IV. *A partial eclipse of the Sun*, July 1. See map on page 76. The eclipse begins at 07^h 53^m and ends at 09^h 23^m. It is visible from the southern Indian Ocean.

V. *A partial eclipse of the Sun*, November 25. See map on page 78. The eclipse begins at 04^h 23^m and ends at 08^h 18^m. It is visible from Antarctica, extreme southern Africa, New Zealand, and the extreme southern Atlantic, extreme southern Indian, and extreme southern Pacific Oceans.

VI. *A total eclipse of the Moon*, December 10. See map on page 79. The eclipse begins at 11^h 32^m and ends at 17^h 32^m; the total phase begins at 14^h 06^m and ends at 14^h 58^m. It is visible from Africa, Europe, the Middle East, Asia, Australia, North America, Greenland, and the Indian, Pacific, and Arctic Oceans.

Local circumstances and animations for upcoming eclipses can be found on *The Astronomical Almanac Online* at <http://asa.hmnao.com> or <http://asa.usno.navy.mil>.

Local circumstances and animations for upcoming eclipses can be found on *The Astronomical Almanac Online* at <http://asa.hmnao.com> or <http://asa.usno.navy.mil>.

General Information

The elements and circumstances are computed according to Bessel's method from apparent right ascensions and declinations of the Sun and Moon. Semidiameters of the Sun and Moon used in the calculation of eclipses do not include irradiation. The adopted semidiameter of the Sun at unit distance is $15'59''.64$ from the IAU (1976) Astronomical Constants. The apparent semidiameter of the Moon is equal to $\arcsin(k \sin \pi)$, where π is the Moon's horizontal parallax and k is an adopted constant. In 1982, the IAU adopted $k = 0.272\,5076$, corresponding to the mean radius of Watts' datum as determined by observations of occultations and to the adopted radius of the Earth.

Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between center of figure and center of mass.

Refraction is neglected in calculating solar and lunar eclipses. Because the circumstances of eclipses are calculated for the surface of the ellipsoid, refraction is not included in Besselian element polynomials. For local predictions, corrections for refraction are unnecessary; they are required only in precise comparisons of theory with observation in which many other refinements are also necessary.

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = +67^s.0$. Once an updated value of ΔT is known, the data on these pages may be expressed in Universal Time as follows:

Define $\delta T = \Delta T - \Delta T(A)$, in units of seconds of time.

Change the times of circumstances given in preliminary Universal Time by subtracting δT .

Correct the tabulated longitudes, $\lambda(A)$, using $\lambda = \lambda(A) + 0.00417807 \times \delta T$ (longitudes are in degrees).

Leave all other quantities unchanged.

The correction of δT is included in the Besselian elements.

Longitude is positive to the east, and negative to the west.

Explanation of Solar Eclipse Diagram

The solar eclipse diagrams in *The Astronomical Almanac* show the region over which different phases of each eclipse may be seen and the times at which these phases occur. Each diagram has a series of dashed curves that show the outline of the Moon's penumbra on the Earth's surface at one-hour intervals. Short dashes show the leading edge and long dashes show the trailing edge. Except for certain extreme cases, the shadow outline moves generally from west to east. The Moon's shadow cone first contacts the Earth's surface where "First Contact" is indicated on the diagram. "Last Contact" is where the Moon's shadow cone last contacts the Earth's surface. The path of the central eclipse, whether for a total, annular, or annular-total eclipse, is marked by two closely spaced curves that cut across all of the dashed curves. These two curves mark the extent of the Moon's umbral shadow on the Earth's surface. Viewers within these boundaries will observe a total, annular, or annular-total eclipse and viewers outside these boundaries will see a partial eclipse.

Solid curves labeled "Northern" and "Southern Limit of Eclipse" represent the furthest extent north or south of the Moon's penumbra on the Earth's surface. Viewers outside of

these boundaries will not experience any eclipse. When only one of these two curves appears, only part of the Moon's penumbra touches the Earth; the other part is projected into space north or south of the Earth, and the terminator defines the other limit.

Another set of solid curves appears on some diagrams as two teardrop shapes (or lobes) on either end of the eclipse path, and on other diagrams as a distorted figure eight. These lobes represent in time the intersection of the Moon's penumbra with the Earth's terminator as the eclipse progresses. As time elapses, the Earth's terminator moves east-to-west while the Moon's penumbra moves west-to-east. These lobes connect to form an elongated figure eight on a diagram when part of the Moon's penumbra stays in contact with the Earth's terminator throughout the eclipse. The lobes become two separate teardrop shapes when the Moon's penumbra breaks contact with the Earth's terminator during the beginning of the eclipse and reconnects with it near the end. In the east, the outer portion of the lobe is labeled "Eclipse begins at Sunset" and marks the first contact between the Moon's penumbra and Earth's terminator in the east. Observers on this curve just fail to see the eclipse. The inner part of the lobe is labeled "Eclipse ends at Sunset" and marks the last contact between the Moon's penumbra and the Earth's terminator in the east. Observers on this curve just see the whole eclipse. The curve bisecting this lobe is labeled "Maximum Eclipse at Sunset" and is part of the sunset terminator at maximum eclipse. Viewers in the eastern half of the lobe will see the Sun set before maximum eclipse; *i.e.* see less than half of the eclipse. Viewers in the western half of the lobe will see the Sun set after maximum eclipse; *i.e.* see more than half of the eclipse. A similar description holds for the western lobe except everything occurs at sunrise instead of sunset.

Computing Local Circumstances for Solar Eclipses

The solar eclipse maps show the path of the eclipse, beginning and ending times of the eclipse, and the region of visibility, including restrictions due to rising and setting of the Sun. The short-dash and long-dash lines show, respectively, the progress of the leading and trailing edge of the penumbra; thus, at a given location, times of first and last contact may be interpolated. If further precision is desired, Besselian elements can be utilized.

Besselian elements characterize the geometric position of the shadow of the Moon relative to the Earth. The exterior tangents to the surfaces of the Sun and Moon form the umbral cone; the interior tangents form the penumbral cone. The common axis of these two cones is the axis of the shadow. To form a system of geocentric rectangular coordinates, the geocentric plane perpendicular to the axis of the shadow is taken as the xy -plane. This is called the fundamental plane. The x -axis is the intersection of the fundamental plane with the plane of the equator; it is positive toward the east. The y -axis is positive toward the north. The z -axis is parallel to the axis of the shadow and is positive toward the Moon. The tabular values of x and y are the coordinates, in units of the Earth's equatorial radius, of the intersection of the axis of the shadow with the fundamental plane. The direction of the axis of the shadow is specified by the declination d and hour angle μ of the point on the celestial sphere toward which the axis is directed.

The radius of the umbral cone is regarded as positive for an annular eclipse and negative for a total eclipse. The angles f_1 and f_2 are the angles at which the tangents that form the penumbral and umbral cones, respectively, intersect the axis of the shadow.

To predict accurate local circumstances, calculate the geocentric coordinates $\rho \sin \phi'$ and $\rho \cos \phi'$ from the geodetic latitude ϕ and longitude λ , using the relationships given on pages K11–K12 of *The Astronomical Almanac*. Inclusion of the height h in this calculation is all that is necessary to obtain the local circumstances at high altitudes.

Obtain approximate times for the beginning, middle and end of the eclipse from the eclipse map. For each of these three times compute from the Besselian element polynomials, the values of x , y , $\sin d$, $\cos d$, μ and l_1 (the radius of the penumbra on the fundamental plane), except that at the approximate time of the middle of the eclipse l_2 (the radius of the umbra on the fundamental plane) is required instead of l_1 if the eclipse is central (i.e., total, annular or annular-total). The hourly variations x' , y' of x and y are needed, and may be obtained by evaluating the derivative of the polynomial expressions for x and y . Values of μ' , d' , $\tan f_1$ and $\tan f_2$ are nearly constant throughout the eclipse and are given immediately following the Besselian polynomials.

For each of the three approximate times, calculate the coordinates ξ , η , ζ for the observer and the hourly variations ξ' and η' from

$$\begin{aligned}\xi &= \rho \cos \phi' \sin \theta, \\ \eta &= \rho \sin \phi' \cos d - \rho \cos \phi' \sin d \cos \theta, \\ \zeta &= \rho \sin \phi' \sin d + \rho \cos \phi' \cos d \cos \theta, \\ \xi' &= \mu' \rho \cos \phi' \cos \theta, \\ \eta' &= \mu' \xi \sin d - \zeta d',\end{aligned}$$

where

$$\theta = \mu + \lambda$$

for longitudes measured positive towards the east.

Next, calculate

$$\begin{aligned}u &= x - \xi & u' &= x' - \xi' \\ v &= y - \eta & v' &= y' - \eta' \\ m^2 &= u^2 + v^2 & n^2 &= u'^2 + v'^2 \\ L_i &= l_i - \zeta \tan f_i \\ D &= uu' + vv' \\ \Delta &= \frac{1}{n}(uv' - u'v) \\ \sin \psi &= \frac{\Delta}{L_i}\end{aligned} \quad (m, n > 0)$$

where $i = 1, 2$.

At the approximate times of the beginning and end of the eclipse, L_1 is required. At the approximate time of the middle of the eclipse, L_2 is required if the eclipse is central; L_1 is required if the eclipse is partial.

Neglecting the variation of L , the correction τ to be applied to the approximate time of the middle of the eclipse to obtain the *Universal Time of greatest phase* is

$$\tau = -\frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60. The correction τ to be applied to the approximate times of the beginning and end of the eclipse to obtain the *Universal Times of the penumbral contacts* is

$$\tau = \frac{L_1}{n} \cos \psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

If the eclipse is central, use the approximate time for the middle of the eclipse as a first approximation to the times of umbral contact. The correction τ to be applied to obtain the *Universal Times of the umbral contacts* is

$$\tau = \frac{L_2}{n} \cos \psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

In the last two equations, the ambiguity in the quadrant of ψ is removed by noting that $\cos \psi$ must be *negative* for the beginning of the eclipse, for the beginning of the annular phase, or for the end of the total phase; $\cos \psi$ must be *positive* for the end of the eclipse, the end of the annular phase, or the beginning of the total phase.

For greater accuracy, the times resulting from the calculation outlined above should be used in place of the original approximate times, and the entire procedure repeated at least once. The calculations for each of the contact times and the time of greatest phase should be performed separately.

The *magnitude of greatest partial eclipse*, in units of the solar diameter is

$$M_1 = \frac{L_1 - m}{(2L_1 - 0.5459)},$$

where the value of m at the time of greatest phase is used. If the magnitude is negative at the time of greatest phase, no eclipse is visible from the location.

The *magnitude of the central phase*, in the same units is

$$M_2 = \frac{L_1 - L_2}{(L_1 + L_2)}.$$

The *position angle of a point of contact* measured eastward (counterclockwise) from the north point of the solar limb is given by

$$\tan P = \frac{u}{v},$$

where u and v are evaluated at the times of contacts computed in the final approximation. The quadrant of P is determined by noting that $\sin P$ has the algebraic sign of u , except for the contacts of the total phase, for which $\sin P$ has the opposite sign to u .

The position angle of the point of contact measured eastward from the vertex of the solar limb is given by

$$V = P - C,$$

where C , the parallactic angle, is obtained with sufficient accuracy from

$$\tan C = \frac{\xi}{\eta},$$

with $\sin C$ having the same algebraic sign as ξ , and the results of the final approximation again being used. The vertex point of the solar limb lies on a great circle arc drawn from the zenith to the center of the solar disk.

Lunar Eclipses

A calculator to produce local circumstances of recent and upcoming lunar eclipses is provided at <http://aa.usno.navy.mil/data/docs/LunarEclipse.php>.

In calculating lunar eclipses the radius of the geocentric shadow of the Earth is increased by one-fiftieth part to allow for the effect of the atmosphere. Refraction is neglected in calculating solar and lunar eclipses. Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between center of figure and center of mass.

Explanation of Lunar Eclipse Diagram

Information on lunar eclipses is presented in the form of a diagram consisting of two parts. The upper panel shows the path of the Moon relative to the penumbral and umbral shadows of the Earth. The lower panel shows the visibility of the eclipse from the surface of the Earth. The title of the upper panel includes the type of eclipse, its place in the sequence of eclipses for the year and the Greenwich calendar date of the eclipse. The inner darker circle is the umbral shadow of the Earth and the outer lighter circle is that of the penumbra. The axis of the shadow of the Earth is denoted by (+) with the ecliptic shown for reference purposes. A 30-arcminute scale bar is provided on the right hand side of the diagram and the orientation is given by the cardinal points displayed on the small graphic on the left hand side of the diagram. The position angle (PA) is measured from North point of the lunar disk along the limb of the Moon to the point of contact. It is shown on the graphic by the use of an arc extending anti-clockwise (eastwards) from North terminated with an arrow head.

Moon symbols are plotted at the principal phases of the eclipse to show its position relative to the umbral and penumbral shadows. The UT times of the different phases of the eclipse to the nearest tenth of a minute are printed above or below the Moon symbols as appropriate. P1 and P4 are the first and last external contacts of the penumbra respectively and denote the beginning and end of the penumbral eclipse respectively. U1 and U4 are the first and last external contacts of the umbra denoting the beginning and end of the partial phase of the eclipse respectively. U2 and U3 are the first and last internal contacts of the umbra and denote the beginning and end of the total phase respectively. MID is the middle of the eclipse. The position angle is given for P1 and P4 for penumbral eclipses and U1 and U4 for partial and total eclipses. The UT time of the geocentric opposition in right ascension of the Sun and Moon and the magnitude of the eclipse are given above or below the Moon symbols as appropriate.

The lower panel is a cylindrical equidistant map projection showing the Earth centered on the longitude at which the Moon is in the zenith at the middle of the eclipse. The visibility of the eclipse is displayed by plotting the Moon rise/set terminator for the principal phases of the eclipse for which timing information is provided in the upper panel. The terminator for the middle of the eclipse is not plotted for the sake of clarity.

The unshaded area indicates the region of the Earth from which all the eclipse is visible whereas the darkest shading indicates the area from which the eclipse is invisible. The different shades of gray indicate regions where the Moon is either rising or setting during the principal phases of the eclipse. The Moon is rising on the left hand side of the diagram after the eclipse has started and is setting on the right hand side of the diagram before the eclipse ends. Labels are provided to this effect.

Symbols are plotted showing the locations for which the Moon is in the zenith at the principal phases of the eclipse. The points at which the Moon is in the zenith at P1 and P4 are denoted by (+), at U1 and U4 by (◐) and at U2 and U3 by (◑). These symbols are also plotted on the upper panel where appropriate. The value of ΔT used for the calculation of the eclipse circumstances is given below the diagram. Country boundaries are also provided to assist the user in determining the visibility of the eclipse at a particular location.

I. –Partial Eclipse of the Sun, 2011 January 4**CIRCUMSTANCES OF THE ECLIPSE**

Universal Time of geocentric conjunction in right ascension, January 4^d 9^h 15^m 12^s.558

Julian Date = 2455565.8855620130

		UT			Longitude	Latitude
		d	h	m		
Eclipse begins	Jan.	4	6	40.2	+ 4 28.6	+28 48.9
Greatest eclipse		4	8	50.6	+ 20 54.4	+64 40.7
Eclipse ends		4	11	00.9	+ 77 28.5	+48 42.7

Magnitude of greatest eclipse: 0.8581

BESSELIAN ELEMENTS

Let $t = (UT - 6^h) + .87/3600$ in units of hours.

These equations are valid over the range $0^h.625 \leq t \leq 5^h.183$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of axis of shadow with fundamental plane:

$$\begin{aligned}x &= -1.67989485 + 0.51635192 t + 0.00001645 t^2 - 0.00000651 t^3 \\y &= +0.74328708 + 0.10446529 t + 0.00011945 t^2 - 0.00000146 t^3\end{aligned}$$

Direction of axis of shadow:

$$\begin{aligned}\sin d &= -0.38676383 + 0.00006487 t + 0.00000006 t^2 \\ \cos d &= +0.92217881 + 0.00002718 t + 0.00000003 t^2 \\ \mu &= 268^{\circ}.82046049 + 14.99662458 t + 0.00000179 t^2 - 0.00000006 t^3 - 0.00417807 t^4\end{aligned}$$

Radius of shadow on fundamental plane:

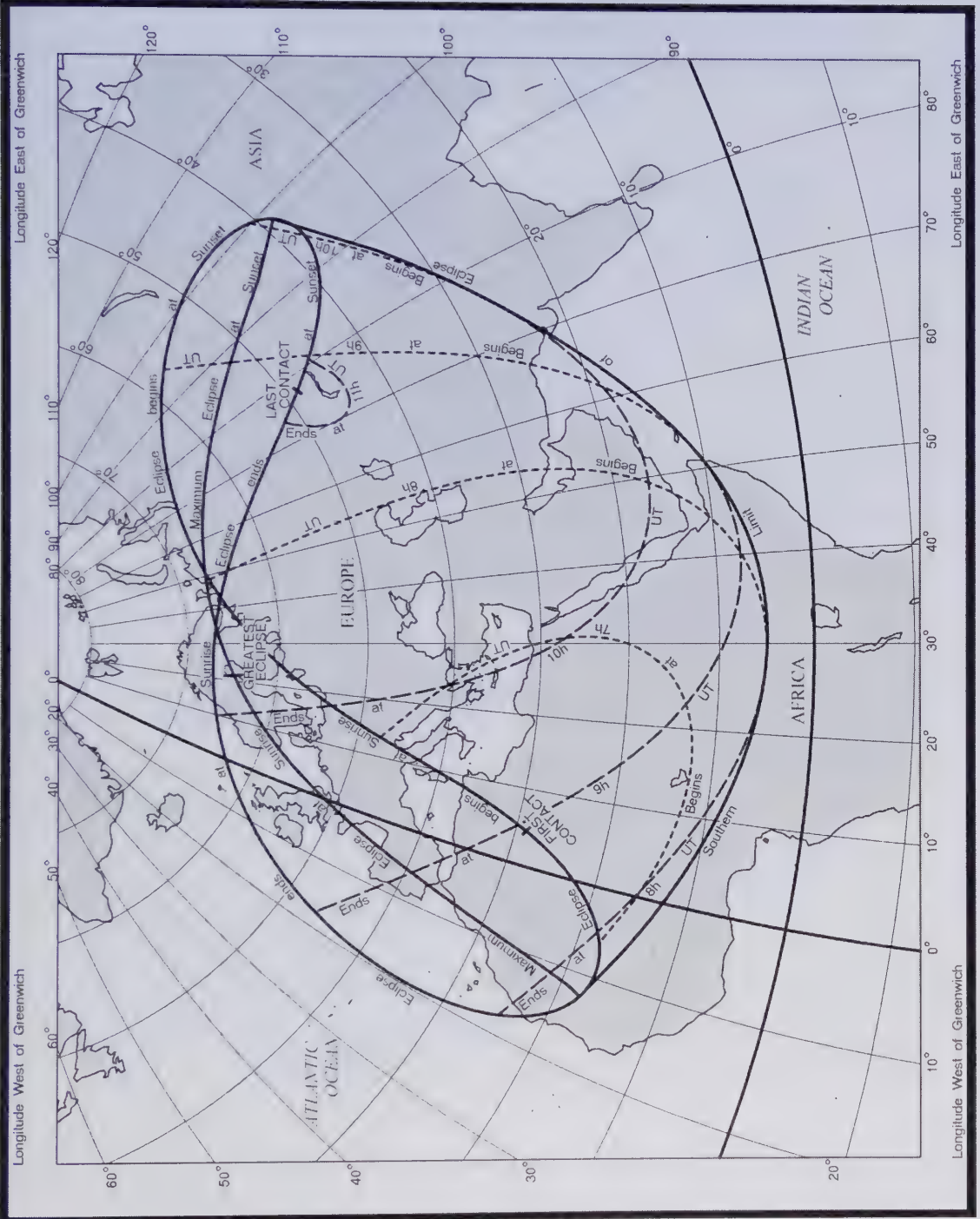
$$\text{penumbra } (l_1) = +0.56319134 + 0.00017420 t - 0.00001084 t^2 + 0.00000001 t^3$$

Other important quantities:

$$\begin{aligned}\tan f_1 &= +0.004756 \\ \mu' &= +0.261741 \text{ radians per hour} \\ d' &= +0.000071 \text{ radians per hour}\end{aligned}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 67^s.0$.

PARTIAL SOLAR ECLIPSE OF 2011 JANUARY 4



II. –Partial Eclipse of the Sun, 2011 June 1

CIRCUMSTANCES OF THE ECLIPSE

Universal Time of geocentric conjunction in right ascension, June 1^d 21^h 21^m 58^s.212

Julian Date = 2455714.3902570810

		UT			Longitude	Latitude
		d	h	m	°	°
Eclipse begins	June	1	19	25.3	+134 45.4	+44 22.3
Greatest eclipse		1	21	16.2	+ 46 45.0	+67 47.0
Eclipse ends		1	23	06.9	– 50 02.3	+48 24.5

Magnitude of greatest eclipse: 0.6014

BESSELIAN ELEMENTS

Let $t = (\text{UT} - 19^{\text{h}}) + 87/3600$ in units of hours.

These equations are valid over the range $0^{\text{h}}.375 \leq t \leq 4^{\text{h}}.283$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of axis of shadow with fundamental plane:

$$\begin{aligned}x &= -1.24509100 + 0.52607886 t + 0.00006908 t^2 - 0.00000663 t^3 \\y &= +1.16076706 + 0.02295849 t - 0.00019175 t^2 - 0.00000023 t^3\end{aligned}$$

Direction of axis of shadow:

$$\begin{aligned}\sin d &= +0.37591710 + 0.00008962 t - 0.00000010 t^2 \\ \cos d &= +0.92665331 - 0.00003639 t + 0.00000005 t^2 \\ \mu &= 105^{\circ}.53738898 + 14.99974974 t - 0.00000107 t^2 - 0.00000004 t^3 - 0.00417807 t^4\end{aligned}$$

Radius of shadow on fundamental plane:

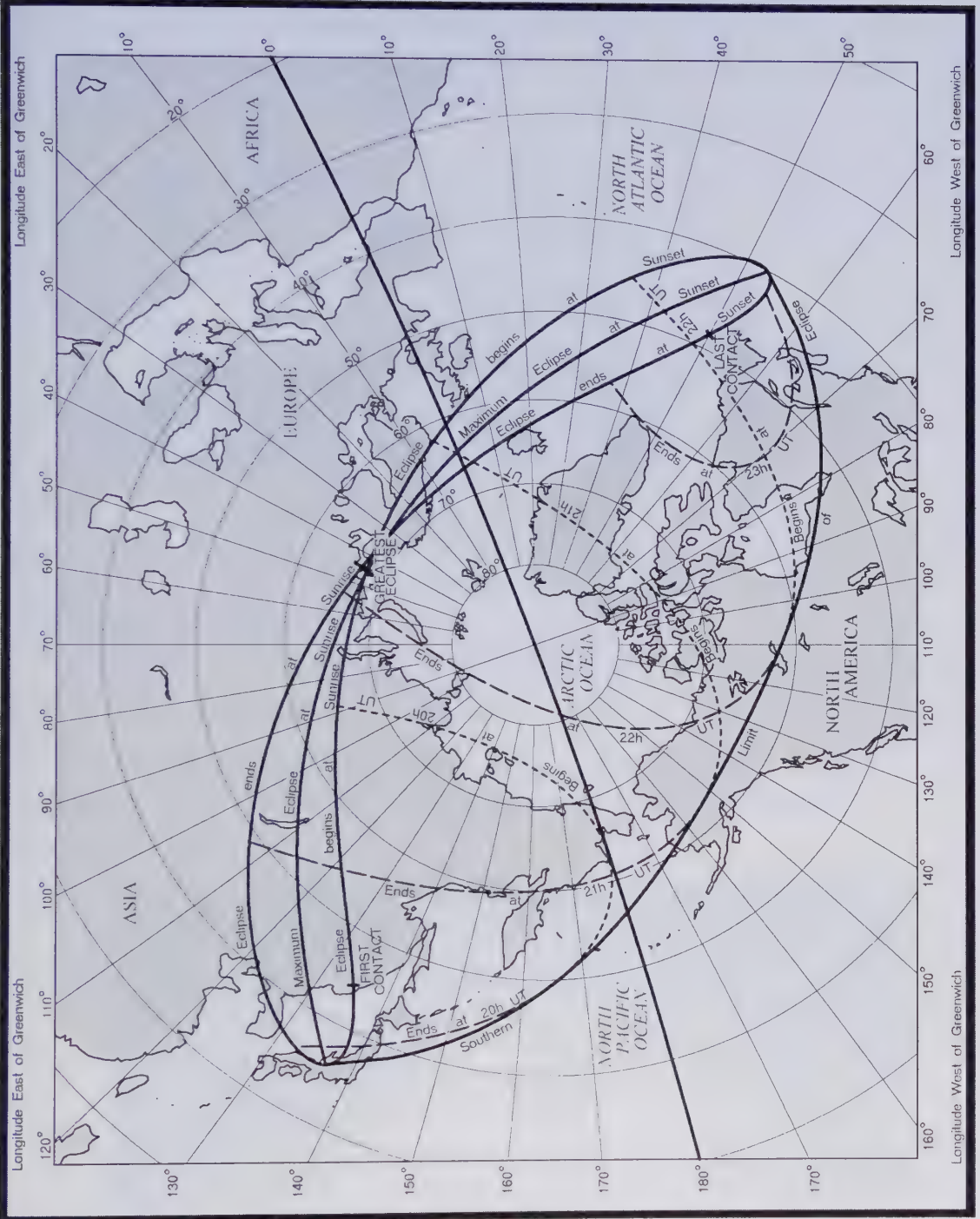
$$\text{penumbra } (l_1) = +0.55639913 - 0.00006130 t - 0.00001035 t^2 - 0.00000002 t^3$$

Other important quantities:

$$\begin{aligned}\tan f_1 &= +0.004611 \\ \mu' &= +0.261795 \text{ radians per hour} \\ d' &= +0.000096 \text{ radians per hour}\end{aligned}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 67^{\circ}.0$.

PARTIAL SOLAR ECLIPSE OF 2011 JUNE 1

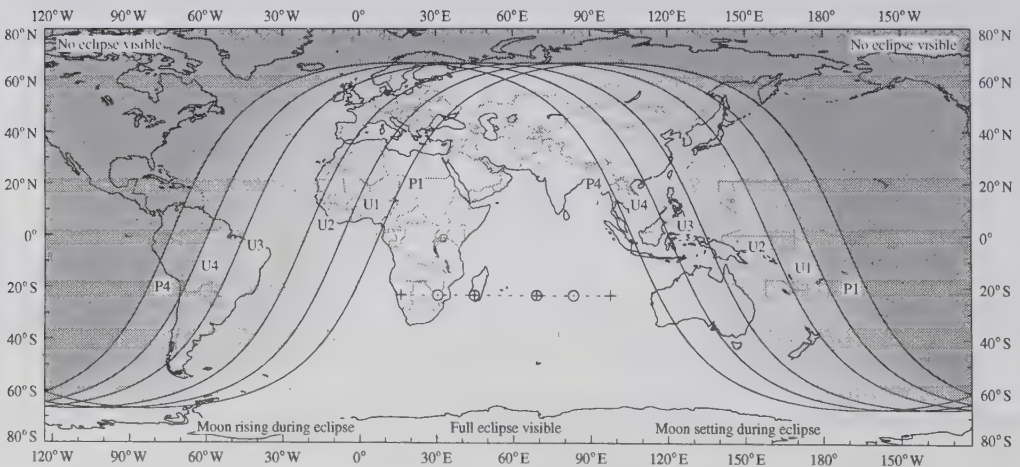
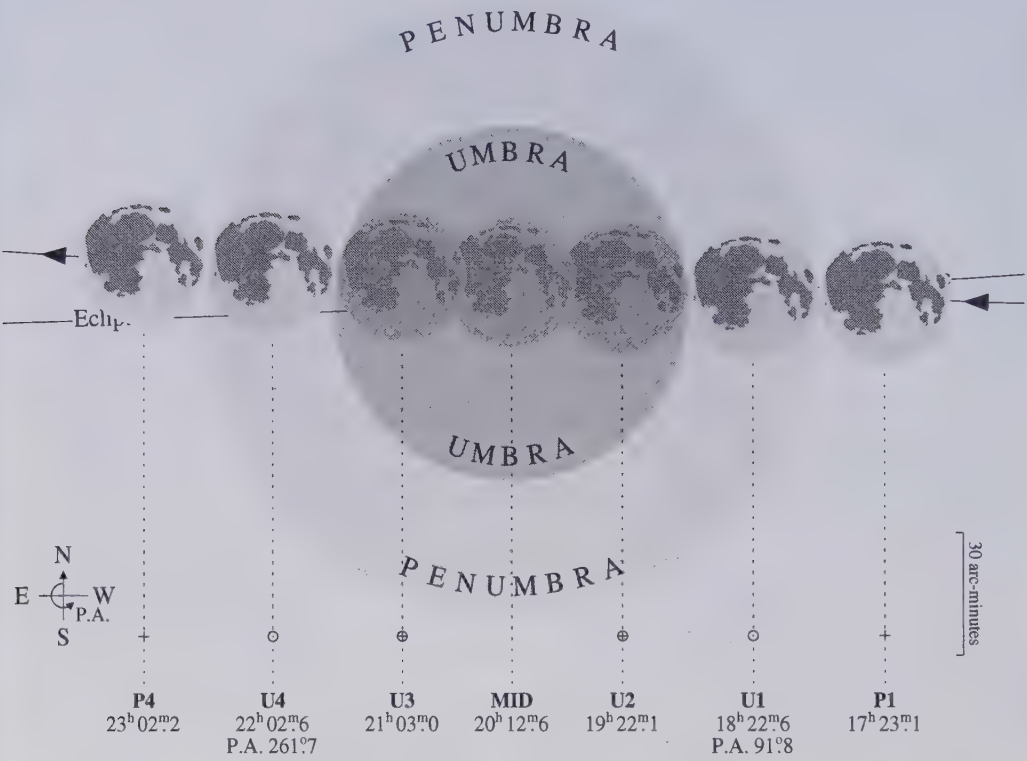


III. - Total Eclipse of the Moon

UT of geocentric opposition in RA: June 15^d 20^h 13^m 8^s.574

2011 June 15

Umbral magnitude of the eclipse: 1.705



IV. -Partial Eclipse of the Sun, 2011 July 1

CIRCUMSTANCES OF THE ECLIPSE

Universal Time of geocentric conjunction in right ascension, July 1^d 9^h 5^m 30^s.732

Julian Date = 2455743.8788279200

		UT			Longitude		Latitude	
		d	h	m	°	'	°	'
Eclipse begins	July	1	7	53.7	+	13 26.2	-56	53.7
Greatest eclipse		1	8	38.4	+	28 44.0	-65	10.6
Eclipse ends		1	9	22.8	+	54 29.5	-66	13.7

Magnitude of greatest eclipse: 0.0970

BESSELIAN ELEMENTS

Let $t = (UT - 8^h) + \delta T / 3600$ in units of hours.

These equations are valid over the range $-0^h.208 \leq t \leq 1^h.550$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of axis of shadow with fundamental plane:

$$\begin{aligned}x &= -0.58470576 + 0.53549800 t + 0.00001766 t^2 - 0.00000733 t^3 \\y &= -1.41565673 - 0.08801558 t - 0.00008755 t^2 + 0.00000151 t^3\end{aligned}$$

Direction of axis of shadow:

$$\begin{aligned}\sin d &= +0.39271379 - 0.00004071 t + 0.00000013 t^2 - 0.00000011 t^3 \\ \cos d &= +0.91966073 + 0.00001748 t - 0.00000022 t^2 + 0.00000013 t^3 \\ \mu &= 299^\circ.05304236 + 14.99935677 t + 0.00000239 t^2 - 0.00000087 t^3 - 0.00417807 \delta T\end{aligned}$$

Radius of shadow on fundamental plane:

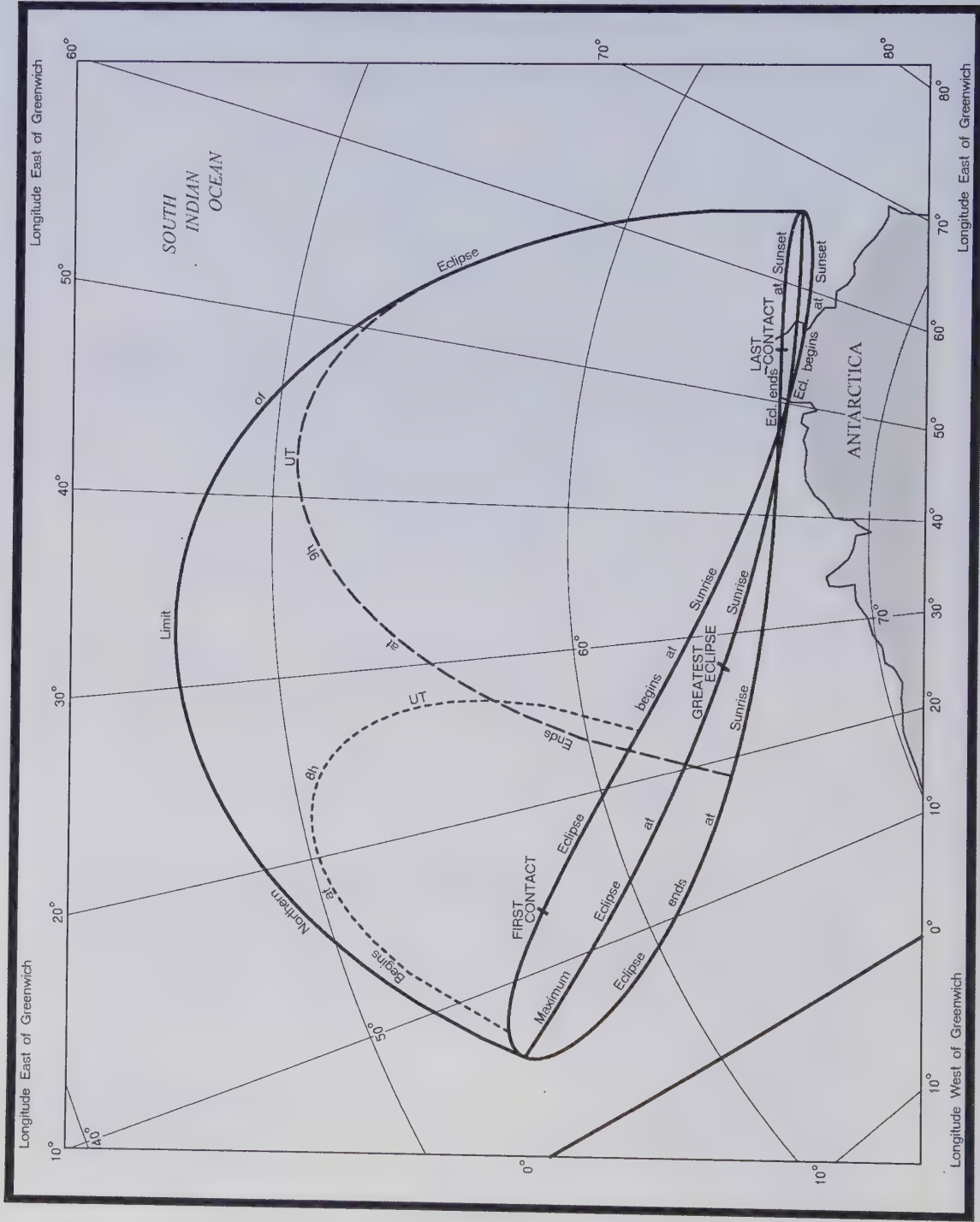
$$\text{penumbra } (l_1) = -0.54790607 - 0.00010526 t - 0.00001123 t^2 - 0.00000001 t^3$$

Other important quantities:

$$\begin{aligned}\tan f_1 &= +0.004599 \\ \mu' &= +0.261788 \text{ radians per hour} \\ d' &= -0.000044 \text{ radians per hour}\end{aligned}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 67^s.0$.

PARTIAL SOLAR ECLIPSE OF 2011 JULY 1



V. –Partial Eclipse of the Sun, 2011 November 25**CIRCUMSTANCES OF THE ECLIPSE**

Universal Time of geocentric conjunction in right ascension, November 25^d 6^h 31^m 20^s.492

Julian Date = 2455890.7717649500

		UT			Longitude		Latitude	
		d	h	m	°	'	°	'
Eclipse begins	Nov.	25	4	23.3	+	5 42.0	–34	46.7
Greatest eclipse		25	6	20.3	–	82 31.8	–68	34.6
Eclipse ends		25	8	17.3	+	164 34.4	–44	59.1

Magnitude of greatest eclipse: 0.9049

BESSELIAN ELEMENTS

Let $t = (\text{UT} - 4^{\text{h}}) + \delta T/3600$ in units of hours.

These equations are valid over the range $0^{\text{h}}.292 \leq t \leq 4^{\text{h}}.458$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of axis of shadow with fundamental plane:

$$\begin{aligned}x &= -1.44492697 + 0.57271471 t + 0.00007634 t^2 - 0.00000939 t^3 \\y &= -0.91224844 - 0.05870578 t + 0.00020565 t^2 + 0.00000082 t^3\end{aligned}$$

Direction of axis of shadow:

$$\begin{aligned}\sin d &= -0.35283367 - 0.00013265 t + 0.00000011 t^2 \\ \cos d &= +0.93568600 - 0.00004995 t \\ \mu &= 243^{\circ}.30175657 + 14.99840421 t - 0.00000066 t^2 - 0.00000026 t^3 - 0.00417807 \delta T\end{aligned}$$

Radius of shadow on fundamental plane:

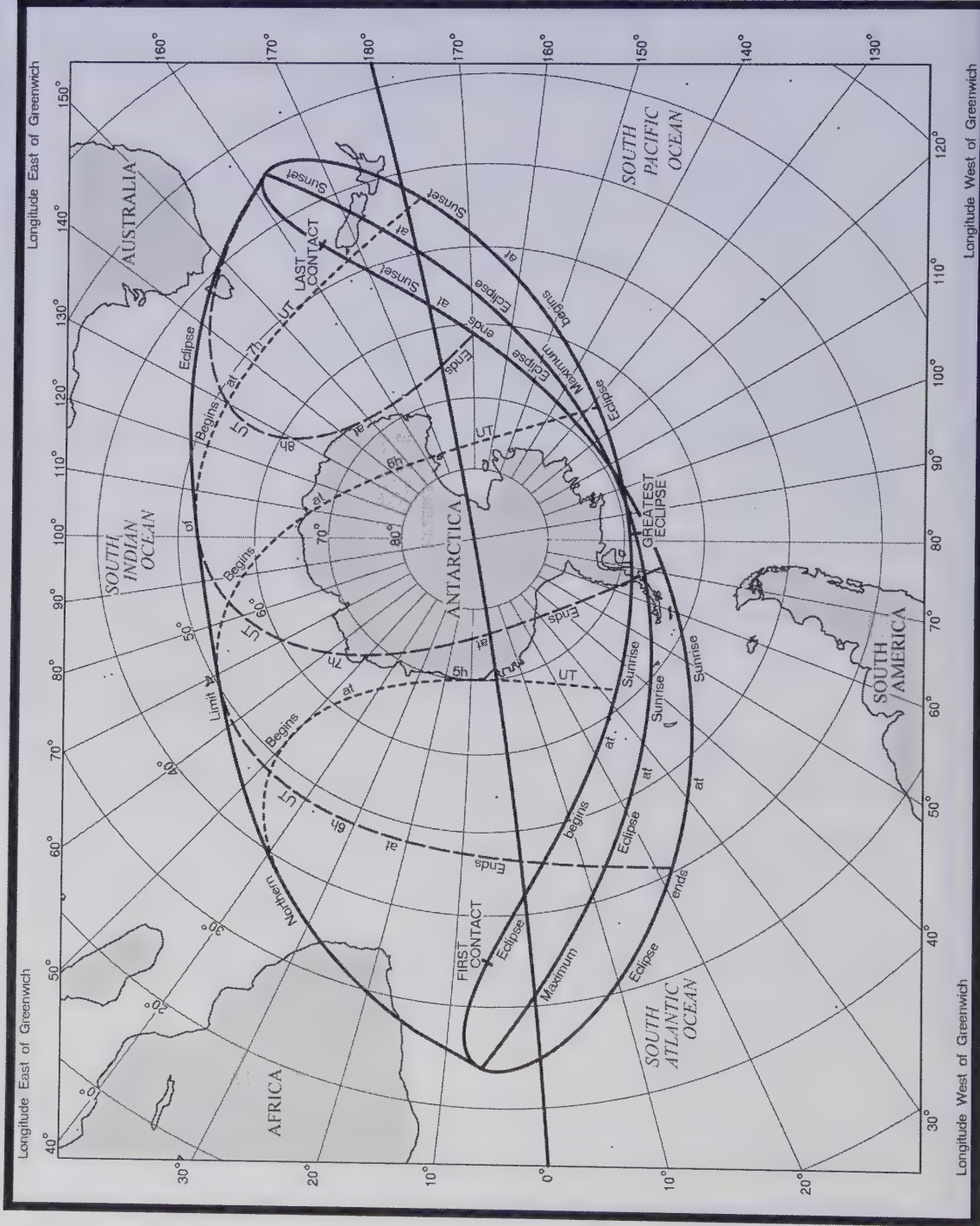
$$\text{penumbra } (l_1) = +0.54041286 + 0.00013328 t - 0.00001297 t^2 + 0.00000002 t^3$$

Other important quantities:

$$\begin{aligned}\tan f_1 &= +0.004736 \\ \mu' &= +0.261771 \text{ radians per hour} \\ \mathcal{A} &= -0.000141 \text{ radians per hour}\end{aligned}$$

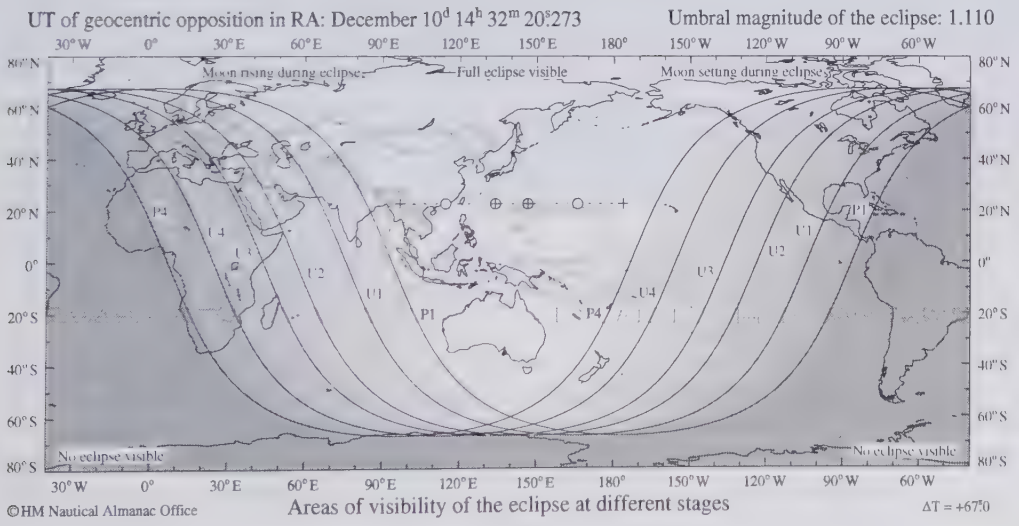
All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 67^{\text{s}}.0$.

PARTIAL SOLAR ECLIPSE OF 2011 NOVEMBER 25



VI. - Total Eclipse of the Moon

2011 December 10



Joint publications of HM Nautical Almanac Office (UKHO) and the United States Naval Observatory

These publications are published by and available from, UKHO Distributors, and the Superintendent of Documents, U.S. Government Printing Office (USGPO) except where noted.

The Astronomical Almanac (AsA) and *The Astronomical Almanac Online* (AsA Online) contain ephemerides of the Sun, Moon, planets and their natural satellites, as well as data on eclipses and other astronomical phenomena. The AsA is an annual volume while AsA Online is updated annually. The data are calculated cooperatively by the British and American offices. A full list of contributors is given on page vii of the AsA and on AsA Online.

The Nautical Almanac contains ephemerides at an interval of one hour and auxiliary astronomical data for marine navigation.

The Air Almanac contains ephemerides at an interval of ten minutes and auxiliary astronomical data for air navigation. This publication is now distributed solely on CD-ROM and is only available from USGPO.

Other publications of HM Nautical Almanac Office (UKHO)

The Star Almanac for Land Surveyors (NP 321) contains the Greenwich hour angle of Aries and the position of the Sun, tabulated for every six hours, and represented by monthly polynomial coefficients. Positions of all stars brighter than magnitude 4.0 are tabulated monthly to a precision of 0.1 in right ascension and 1" in declination. A CD-ROM is included which contains the electronic edition plus coefficients, in ASCII format, representing the data.

NavPac and Compact Data for 2006–2010 (DP 330) contains software, algorithms and data, which are mainly in the form of polynomial coefficients, for calculating the positions of the Sun, Moon, navigational planets and bright stars. It enables navigators to compute their position at sea from sextant observations using an IBM PC or compatible for the period 1986–2010. The tabular data are also supplied as ASCII files on the CD-ROM.

Planetary and Lunar Coordinates, 2001–2020 provides low-precision astronomical data and phenomena for use well in advance of the annual ephemerides. It contains heliocentric, geocentric, spherical and rectangular coordinates of the Sun, Moon and planets, eclipse maps and auxiliary data. All the tabular ephemerides are supplied solely on CD-ROM as ASCII and Adobe's portable document format files. The full printed edition is published in the United States by Willmann-Bell Inc, PO Box 35025, Richmond VA 23235, USA.

Rapid Sight Reduction Tables for Navigation (AP 3270 / NP 303), 3 volumes, formerly entitled *Sight Reduction Tables for Air Navigation*. Volume 1, selected stars for epoch 2010.0, containing the altitude to 1' and true azimuth to 1° for the seven stars most suitable for navigation, for all latitudes and hour angles of Aries. Volumes 2 and 3 contain altitudes to 1' and azimuths to 1° for integral degrees of declination from N 29° to S 29°, for relevant latitudes and all hour angles at which the zenith distance is less than 95° providing for sights of the Sun, Moon and planets.

Sight Reduction Tables for Marine Navigation (NP 401), 6 volumes. This series is designed to effect all solutions of the navigational triangle and is intended for use with *The Nautical Almanac*.

The UK Air Almanac contains data useful in the planning of activities where the level of illumination is important, particularly aircraft movements, and is produced to the general requirements of the Royal Air Force.

NAO Technical Notes are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

Other publications of the United States Naval Observatory

Astronomical Papers of the American Ephemeris[†] are issued irregularly and contain reports of research in celestial mechanics with particular relevance to ephemerides.

U.S. Naval Observatory Circulars[†] are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

U.S. Naval Observatory Circular No. 179, The IAU Resolutions on Astronomical Reference Systems, Time Scales, and Earth Rotation Models explains resolutions and their effects on the data, and available at http://aa.usno.navy.mil/publications/docs/Circular_179.php.

Explanatory Supplement to The Astronomical Almanac edited by P. Kenneth Seidelmann of the U.S. Naval Observatory. This book is an authoritative source on the basis and derivation of information contained in *The Astronomical Almanac*, and it contains material that is relevant to positional and dynamical astronomy and to chronology. It includes details of the FK5 J2000-0 reference system and transformations. The publication is a collaborative work with authors from the U.S. Naval Observatory, H.M. Nautical Almanac Office, the Jet Propulsion Laboratory and the Bureau des Longitudes. It is published by, and available from, University Science Books, 55D Gate Five Road, Sausalito, CA 94965, whose UK distributor is Macmillan.

MICA is an interactive astronomical almanac for professional applications. Software for both PC systems with Intel processors and Apple Macintosh computers is provided on a single CD-ROM. *MICA* allows a user to compute, to full precision, much of the tabular data contained in *The Astronomical Almanac*, as well as data for specific times and locations. All calculations are made in real time and data are not interpolated from tables. *MICA* is a product of the U.S. Naval Observatory; it is published by and available from Willmann-Bell Inc. The latest version covers the interval 1800-2050.

† Many of these publications are available from the Nautical Almanac Office, U.S. Naval Observatory, Washington, DC 20392-5420, see <http://aa.usno.navy.mil/> for availability.

Publications of other countries

Apparent Places of Fundamental Stars is prepared by the Astronomisches Rechen-Institut, Heidelberg (www.ari.uni-heidelberg.de). The printed version of APFS gives the data for a few fundamental stars only, together with the explanation and examples. The apparent places of stars using the FK6 or Hipparcos catalogues are provided by the on-line database ARIAPFS (www.ari.uni-heidelberg.de/ariapfs). The printed booklet also contains the so-called '10-Day-Stars' and the 'Circumpolar Stars' and is available from Verlag G. Braun, Karl-Friedrich-Strasse, 14-18, Karlsruhe, Germany.

Ephemerides of Minor Planets is prepared annually by the Institute of Applied Astronomy (www.ipa.nw.ru), and published by the Russian Academy of Sciences. Included in this volume are elements, opposition dates and opposition ephemerides of all numbered minor planets. This volume is available from the Institute of Theoretical Astronomy, Naberezhnaya Kutuzova 10, 191187 St. Petersburg, Russia.

Electronic Publications

The Astronomical Almanac Online: The companion publication of *The Astronomical Almanac*, providing data best presented in machine-readable form. It typically does not duplicate the data from the book. It does, in some cases, provide additional information or greater precision than the printed data. Examples of data found on *The Astronomical Almanac Online* are searchable databases, eclipse and occultation maps, errata found in the printed publication, and a searchable glossary. It is available at

<http://asa.usno.navy.mil> —  — <http://asa.hmnao.com>

Please refer to the relevant World Wide Web address for further details about the publications and services provided by the following organisations.

U.S. Naval Observatory

- Astronomical Applications at <http://aa.usno.navy.mil>
- *The Astronomical Almanac Online* at <http://asa.usno.navy.mil>
- *USNO Circular 179* at http://aa.usno.navy.mil/publications/docs/Circular_179.php
- USNO Julian/Calendar date conversion at <http://aa.usno.navy.mil/data/docs/JulianDate.php>

H.M. Nautical Almanac Office

- General information at <http://www.hmnao.com>
- *The Astronomical Almanac Online* at <http://asa.hmnao.com>
- Eclipses Online at <http://www.eclipse.org.uk>
- Online data services at <http://websurf.hmnao.com>
- MoonWatch at <http://www.crescentmoonwatch.org>

International Astronomical Organizations

- IAU: International Astronomical Union at <http://www.iau.org>
- IERS: International Earth Rotation and Reference Systems Service at <http://www.iers.org>
- SOFA: IAU Standards of Fundamental Astronomy at <http://iau-sofa.hmnao.com>
- CDS: Centre de Données astronomiques de Strasbourg at <http://cdsweb.u-strasbg.fr>

Publishers and Suppliers

- The UK Hydrographic Office (UKHO) at <http://www.ukho.gov.uk>
- The Stationery Office (TSO) at <http://www.tso.co.uk/> and at <http://www.tsoshop.co.uk>
- U.S. Government Printing Office at <http://www.gpoaccess.gov>
- University Science Books at <http://www.uscibooks.com>
- Willmann-Bell at <http://www.willbell.com>
- Macmillan Distribution at <http://www.palgrave.com>



ISBN 0-16-082126-X



9 780160 821264

90000



*
W3-BIO-022
*